British Society for the Study of Orthodontics.

1933

TRANSACTIONS

OF THE

British Society for the Study of Orthodontics

1933

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British Society for Study of Orthodontics

[*January 1st*, 1934.

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British Society for the Study of Orthodontics.

An ordinary meeting of the society was held at Manson House, 26, Portland Place, on Monday, January 16th, 1933, at 8 p.m., with the President, Mr. H. G. Watkin, in the chair. The Hon. Secretary read the minutes of the annual general meeting, held on December 5th, 1932, and they were signed by the President as correct.

The President extended a welcome to all visitors and invited them to consider themselves members for the evening, and to take part in any discussion that might take place.

An ordinary meeting of the Society took place at Manson House, Portland Place, W.1, on Monday, February 6th, 1933, with Mr. H. G. Watkin, President, in the chair.

The President said that the thanks of the Society were due to Mr. Highton for enabling the Society's cabinets to be housed in the balcony of the house, and he hoped that any member who had interesting specimens would bring them forward.

Mr. Hayton-Williams then read a short Communication on "Abnormalities treated by Extraction rather than by Appliances," and models were handed round.

A paper was then read: "Practical Application of Stainless Steel to Fixed Orthodontic Appliances," by Dr. E. S. Friel.

An ordinary meeting of the Society was held at Manson House, 26, Portland Place, W.1, on Monday, March 6th, 1933, with the President, Mr. H. G. Watkin, in the chair.

Mr. E. A. Hardy read a short Communication on "Possibilities in the Orthodontic Treatment of an Adolescent case of Double Hair Lip and Cleft Palate."

The reading of the Communication was followed by the exhibition of a cinematograph film.

A DEMONSTRATION MEETING was held on Monday, May 1st, at 8 p.m.

Mr. H. G. WATKIN : "Electric Welding and Stainless Steel."

Mr. O. HENRY : "Demonstration of the Working of the Crozat Appliance."

Mr. L. M. MARKHAM : "The Skeletal Band, and its Application to Orthodontics."

Mr. H. R. EVANS : "Cases and Appliances."

Miss L. M. CLINCH : "The Construction of Incisor, Canine, and Premolar Bands."

AN ordinary meeting was held on Monday, October 2nd, 1933.

The President, Mr. H. G. WATKIN, took the chair at 8 p.m.

The Honarary Secretary read the minutes of the last meeting, held on Monday, May 1st, 1933. By unanimous consent of the meeting, they were signed by the President as correct.

OBITUARY.

The PRESIDENT announced to the meeting, all members standing as a mark of respect, the death of two members of the society, Mr. M. Davie and Mr. Rous Mallory. Mr. Davie, he said, had been one of the most valuable of the society's provincial members ; he had been a member for a long time and had not infrequently read papers and communications during the last few years. Mr. Mallory, although he had not been a member at the time of his death, was well known to most of those present. Letters of sympathy had been sent to the relatives of both of these gentlemen.

INTRODUCTION OF NEW MEMBER.

Mr. S. G. ROBINSON came forward and was introduced by the Honorary Secretary to the President, who welcomed him warmly on behalf of the society.

ELECTION OF CANDIDATES.

The following candidates were elected unanimously, in mass, to be members of the society : P. G. Capon, L.D.S.Liv., 49a, Rodney Street, Liverpool ; H. H. Stones, M.B., Ch.B., B.D.S., 28, Eversfield Road, St. Leonards-on-Sea ; N. Salanca, B.Ch.D.Egypt, L.D.S.Eng., London Hospital, E.1 ; Miss B. C. Hamilton, L.D.S., L.R.C.P.Edin., 77, Langbourne Mansions, N.6 ; S. A. McLaren, L.D.S., R.C.S.Eng., 5, The Mansions, Alexandra Park Road, N.22 ; E. E. Wookey, L.D.S., R.C.S.Eng., 26, Wimpole Street, W.1 ; M. H. G. Sturridge, L.D.S., D.D.S.Penn., 75, Grosvenor Street, W.1.

The PRESIDENT welcomed all visitors present and invited them to consider themselves members for the evening, and to take part in the discussions. He extended a special welcome to a visitor from the Antipodes.

A MEETING of the Society was held at Manson House, Portland Place, W., on Monday, November 6th, 1933, Mr. H. G. WATKIN, President, in the chair.

Mr. R. BRADLAW read a short Communication on "An Inheritance of Missing or Abortive Upper Lateral Incisors in Three Generations."

TREATED CASES.*

By H. G. Watkin, L.D.S.

My first duty this evening is to thank you all most sincerely for elevating me to the honoured position of president, and I only hope that I shall discharge the duties and obligations of the office as ably and satisfactorily as my immediate predecessor, Mr. Carl Schelling; in fact, if I achieve this object I shall be more than satisfied and shall feel that my efforts shall not have been in vain.

On personal retrospection it is interesting to recall that approximately eleven years ago, when in the capacity of a mere novitiate in the science and practice of orthodontics, I was giving a demonstration at the annual meeting of the British Dental Association at Bath, I was invited to join the British Society for the Study of Orthodontics by two prominent members, viz., our President-elect, Mr. Bertram Samuel, and our much respected member, Mr. J. H. Badcock. These gentlemen were primarily instrumental in my becoming a member of this Society, and I feel it incumbent upon me to take this opportunity of publicly thanking them for the benefits and amenities which I have received and for which they have been indirectly responsible. Little did I think then that in such a comparatively short space of time I should occupy this chair as your president.

In choosing the subject of my presidential address I must confess that I found it extremely difficult, if not impossible, to select a subject essentially original, and in consequence I have decided to give you practical details of treatments, and have, therefore, entitled my subject "Treated Cases." Although the title may not convey much originality, I feel sure that some points at least will prove of considerable interest to you. The subject is a practical one, and will be illustrated by lantern slides, so that it will be more in the nature of a demonstration than an address. I am perfectly aware that a presidential demonstration as opposed to a presidential address may seem to some to be unconventional and unorthodox, but of these I crave indulgence. Furthermore I must ask the older members to be especially sympathetic if in the course of my address I appear to be reiterating and trespassing on ground which is not absolutely novel to them but which, nevertheless, may prove to be of considerable and topical interest to some of our younger members present.

Before showing the slides I should like to say a few words about stainless steel. Whilst stainless steel has held a place of high value in general dentistry for some years, its utility as an orthodontic material has only been recognised in recent years. Many

* Presidential Address to British Society for the Study of Orthodontics, January, 1933.

obstacles had to be overcome by the pioneers in its adaptation to orthodontics, and only by patience and diligence have these been conquered. The chief difficulty in the past has been the making of an efficient joint between two pieces of the metal without loss of temper, and even to-day I have yet to see a welding machine which will weld together two pieces of stainless steel without loss of temper in one or other of the pieces. The technique of soldering stainless steel was considerably improved by the introduction of a special flux and a silver solder of very low melting point.

There are two methods of effecting a joint in stainless steel, viz., soldering and welding; both have advantages and disadvantages and, whilst not wishing to be biased by the qualities of either, I should like to point out that each method has individual advantages when used in its own sphere. In fact, a soldered and a welded joint may work harmoniously side by side on the same piece of apparatus where two like joints are more difficult to effect. There are two factors which govern the choice of soldering or welding: (1) if you desire to retain temper, soldering is indicated; (2) if, however, as in seaming bands, loss of temper is of no importance, or where two flat surfaces have to be joined, then welding is the better method.

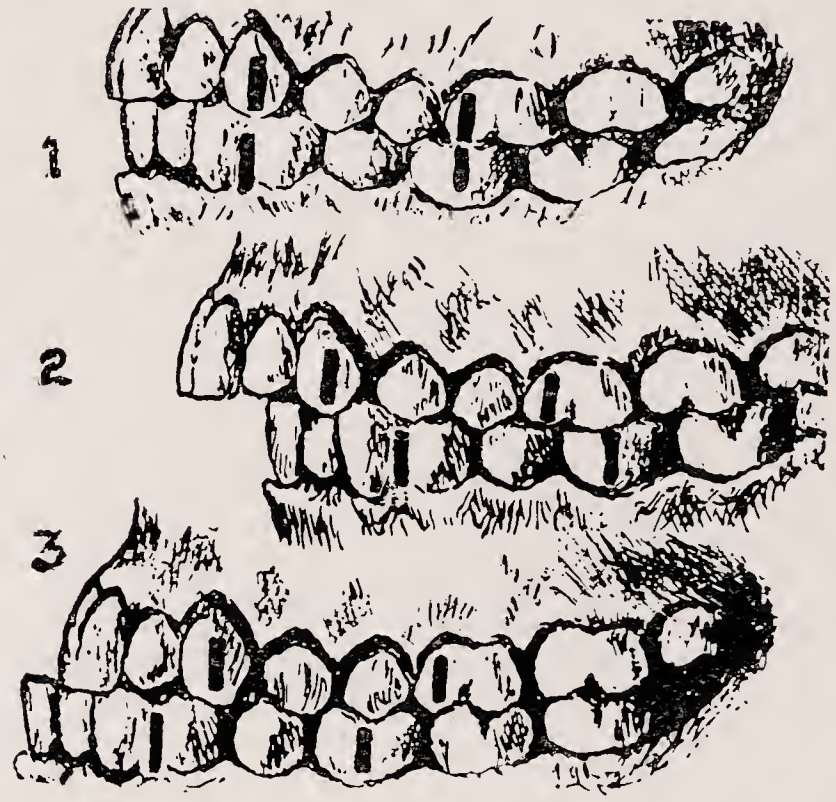


Fig. 1

Figure 1 demonstrates Angle's Classification. (1) In the top sketch, which will be familiar to most of you, we have the normal marks; the upper molar is slightly distal to the lower molar—also note the canine marks. When the molars occlude normally on both sides, the case falls into Class I according to Angle. (2) In Class II the lower molar is one unit or cusp distal to normal, and (3) in Class III the lower molar is one unit or cusp medial to normal. (Canines and premolars = 1 unit, molar = 2 units.)

I should like for a few minutes to speak of extractions. In Class I the molars being in normal occlusion there is a balance of the units between the arches of each jaw anterior to the molars and when that is the case, if an extraction is performed in one arch there must be another compensating extraction in the other arch if a balance of units is to be maintained. In Class II, since the lower arch is post-normal to the upper arch, it is sometimes

advantageous to remove one or more units from the upper arch and none from the lower arch. If it is post-normal on both sides the indication would probably be to remove two units from the upper arch and none from the lower arch. In Class III the reverse is the case. It may be of advantage to remove one unit or more from the mandible and none from the maxilla.

Figure 2 demonstrates the pressure exerted by the tongue inside and the cheeks and lips outside the mouth. The teeth are in a state of equilibrium in a definite trough between the two opposing forces and are irregular, and as you expand the jaw so as to make the teeth less irregular they will occupy a wider space and the external pressure will be increased and the internal pressure reduced.

Figure 3.—In Fig. 3 the tongue is of the same size as in the previous diagram, but the teeth are arranged regularly, as might be accomplished with an expansion apparatus, so that the tongue does not now exert any internal pressure. The teeth are artificially pressed into the cheeks, and when the appliance which has expanded them is removed, they will very probably relapse and the condition possibly be worse than the original one. By extraction the number of units is reduced and it is quite possible to arrange a reduced number in the same trough between the two forces and to have all the teeth in equilibrium and no relapse.

I would now like to say a few words about the soft tissues.

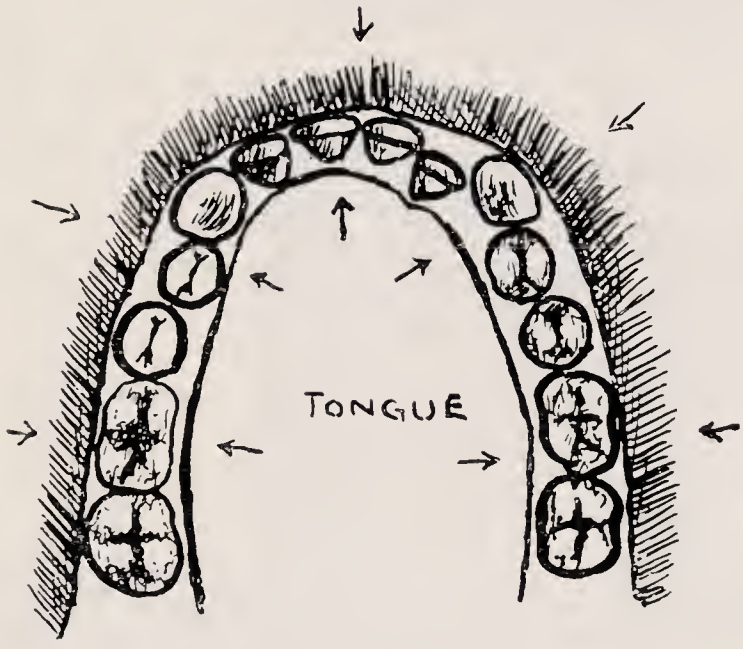


Fig. 2

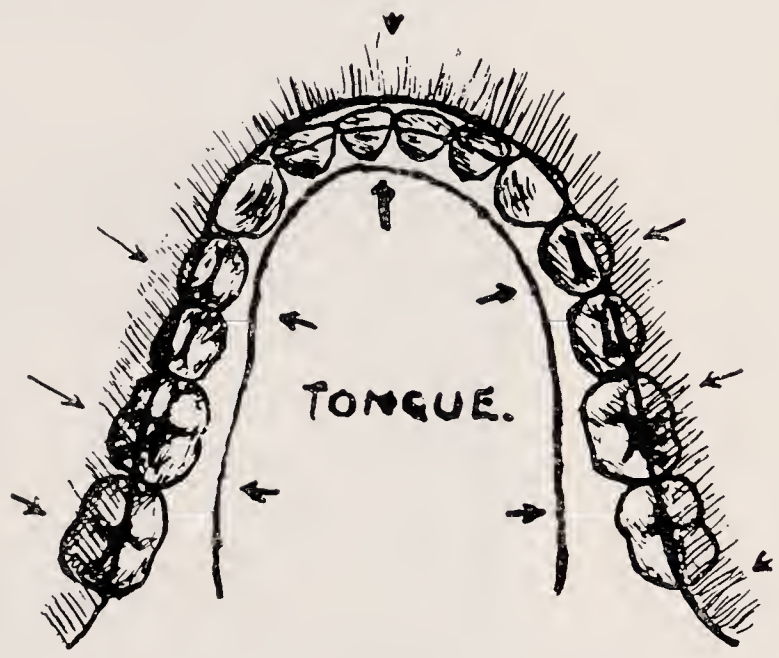


Fig. 3

Figure 4 is of a child aged 4, a thumb-sucker. The pressure of habitually sucking the thumb, probably only at night, has prevented the eruption of the incisor teeth. My daughter who, when about 5, used to suck a finger (a habit we could not correct), was later shown this photograph and told that she would not be able to eat a piece of bread and butter if she did not give up the habit. After she heard that she never sucked her finger again, so it was quite a useful photograph. I have told several parents this story and they have been successful with the same method. To play on the child's vanity is often much more successful than any appliance.

Figure 5 illustrates a Class I case, where one tooth only is in front of the lower lip; the other teeth are in normal position. The prominent tooth, of course, will remain there; the lip is holding it forward.

Fig. 4

Fig. 5

Figure 6 is a model of the mouth of the same patient showing the prominent tooth.

Figure 7 shows two incisors forward and the rest normal. Probably the deciduous centrals were left in too long. They were lingual to the permanent centrals and have pushed them just over the lower lip. The defect is, of course, fairly easy to correct.

I should like special note to be made of *Figure* 8. It is a case, again, where the trouble is partly due to the lip. It is a Class I case ; the molars are normal. Here the tongue is pushing the

lower incisors forward ; the lower lip normally would hold the upper incisors back, but it is underneath the upper incisors. The lower lip is now holding the upper incisors forward and the lowers backwards. By fixing bands on the first deciduous lower molars and putting a labial bow in front, not touching any of the incisor teeth so as to remove the force of the lip, the tongue acting alone will move the lower front teeth forward. In a short time the teeth will touch the bow. The bow is then lengthened and after another short time the lower lip slips in front of the upper incisors, and they will move backwards, so that the regulation has been accomplished without any apparatus touching any of the permanent teeth. Two bands were put on the lower deciduous molars and the bow did not touch any other teeth.

Fig. 6

Fig. 7

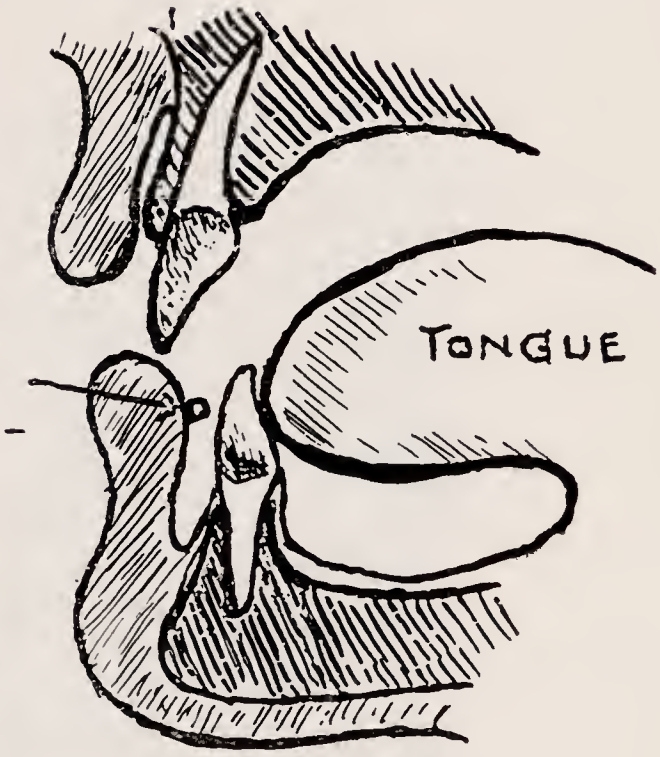


Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Figure 9 still bears on the action of the soft tissues. This is a Class I case; the molars were normal; the $\overline{|\,5}$ is unerupted; X-rays show $\overline{4\ 5\,|}$ present but impacted, and therefore they cannot come into normal position. The $\overline{3\,|}$ is almost up against $\overline{6\,|}$. The thumb has pushed the upper incisors forward and the lower incisors backwards and caused the impaction of the lower premolars. Everything else is normal.

Figure 10 demonstrates the result of moving the lower incisors forward and the upper incisors backwards, thus allowing $\overline{5\,4\,|\,5}$ to erupt. I introduced this case to show the extreme action of thumb-sucking. The child was 12 years and 8 months old when she came to me, and the thumb-sucking effect was maintained by the action of the lower lip. The thumb-sucking initiates the damage by forcing the front teeth into an abnormal position and the lip continues the deformity to later years when the thumb-sucking has ceased. In due course, after treatment, the lower lip passed in front of the upper teeth and this maintains proper occlusion of the incisors.

Figure 11 illustrates a case in which the lower right molar has been removed at an early age with no compensating extraction in the upper arch. The result is that a few years later the $\underline{3\,|}$ erupts out of the arch altogether and you can note this irregularity on the right side. This displacement is due to the fact that there has been one lower extraction with no compensating extraction from the maxilla. The left side of this patient is normal.

Figure 12 is an occlusal view of the same two models. The $\overline{6\,|}$ was extracted and the $\underline{3\,|}$ is outside the arch.

Fig. 13A

Fig. 13B

Figures 13A and 13B show a comparison of the right and wrong ways to proceed. A child consults the dentist with a faulty tooth, and he says, " Oh, we'll have it out "—no further explanation. The $\overline{6}|$ is taken out and the $|\overline{6}$ has been taken out soon afterwards. At this stage it is a Class I case. The left-hand models (A) show the case a few years later. The spaces are nearly closed up and the front upper teeth are crowded out owing to the extractions from the mandible only with no compensating extractions from the maxilla. The right-hand Fig. (B) shows the result of symmetrical extraction. It is difficult to persuade parents to allow a good tooth to be taken out, but if they are shown a comparison such as this and are told that if they do not have the upper tooth or teeth taken out as well as the lower, then Fig. (A), viz., overcrowding, will be the result in a few years' time, and if they do allow the compensating extractions to be made, Fig. (B) will be the result ; viz., the front teeth in good occlusion and the spaces nearly closed

up (and as time goes on they will entirely close up), with this comparison before them they are generally convinced and agree to the correct extractions. In order to overcome this difficulty I have had printed a number of postcards of Fig. 13A and 13B to persuade parents to allow extraction when it is indicated.

Figure 14 is a photograph of the same patient as in Fig. 13A and demonstrates the disastrous results of taking out the lower molars and not the upper molars. The patient's appearance was marred by the asymmetrical extraction, and she is now a case for the orthodontist.

Fig. 14

In order to overcome the necessity of taking two separate photographs, one full face and one profile, I now place a mirror at an angle of 45 degrees at the side of the patient's head, which enables me to get two views with one exposure—one direct, and the profile by reflection in the mirror.

Figure 15 is a Class I case in which the molars are quite normal, but the incisors are overcrowded, and we have to decide which teeth are to be extracted. I have found that it is generally advantageous to remove the upper first and lower second premolars. The lower picture shows the result (right side) nine months after extraction without the use of any apparatus. The upper premolar which remains in the arch is definitely distal to the lower premolar. No apparatus at all is required to obtain this result (15A). The canines fall into position and the effect is quite good.

Figure 16 shows the same model on the left side. On this side, unfortunately, the second premolar in the upper jaw was carious. Since it is a pity to take a good tooth out when there is a bad one next to it, which would have to be filled in any case, it was decided here to take out the two second premolars instead of the upper first and the lower second. The Fig. 16A shows the result obtained without any apparatus nine months afterwards. It is not nearly as good as the other side, and it now requires apparatus to ensure that the upper premolar shall occlude distal to the lower premolar, otherwise there is a danger that the upper will slip forward and remain anterior to the lower.

Fig. 15

Fig. 15A

Fig. 16

Fig. 13A

Fig. 17

Figure 17.— We all get cases of upper incisors articulating inside the lower. A simple method of dealing with this defect in the early stages is by means of a plate with retention bands on the deciduous molars and a lingual steel wire to push the incisor over. It may be necessary to put a pinch band on the incisor with a little spur at the back to make the plate more stable. This spur prevents the spring wire from sliding down the lingual surface of the incisor.

With a spring a gentle continuous pressure is obtained, obeying physiological conditions, and the result is better than using a hickory peg or a screw, and the appliance is much more comfortable for the patient and more easily adjustable for the orthodontist. One detail that I might mention about these plates with stainless steel wires in them is that there is no adhesion between steel and vulcanite, so that it is absolutely necessary to get a mechanical hold. The wire must be bent into a loop in the vulcanite to obtain good retention. D-shaped wire used for clasps, etc., is best secured by cutting notches in the buried portion.

Figure 18 illustrates the case of a girl aged 18, who was proceeding to France to learn the language and objected to her appearance caused by the marked protrusion of $\underline{1}|$ the result of an early extraction in the lower jaw with none in the upper. As she was older than usual and proceeding abroad I thought it was better to play for safety and take out $\underline{5}|$. I made a plate with a spring wire pressing $\underline{4}|$ backwards; I passed another wire through the gap made by the extraction of $\underline{5}|$ labially, and pressing on the $\underline{1}|$. She then went to Paris for six months.

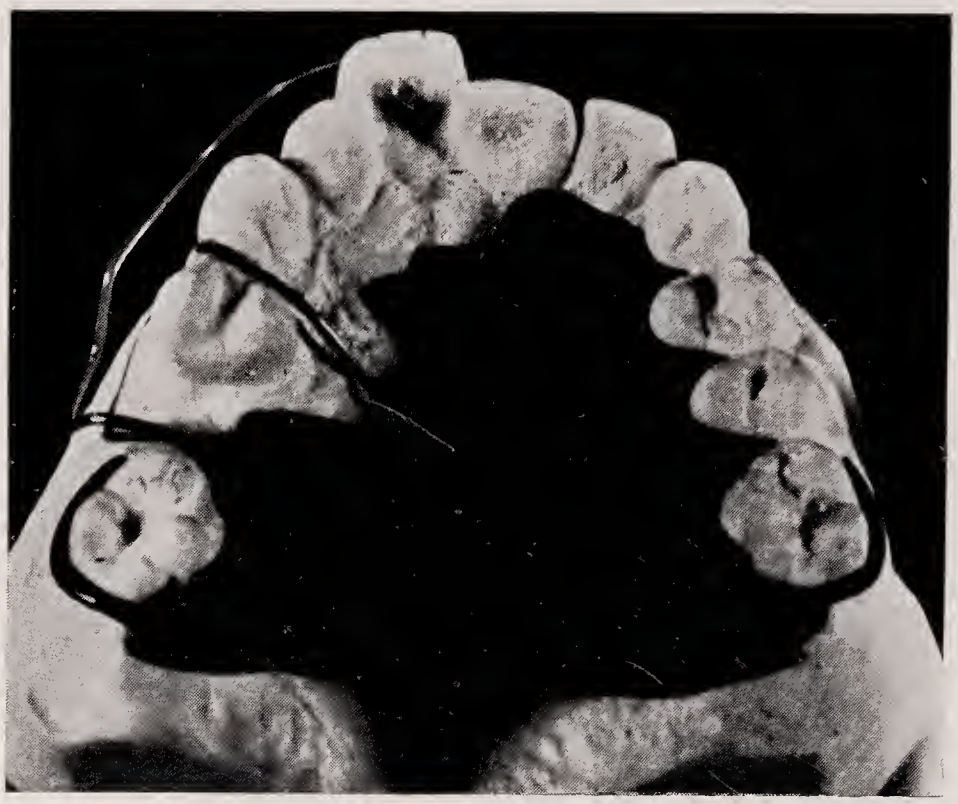


Fig. 18

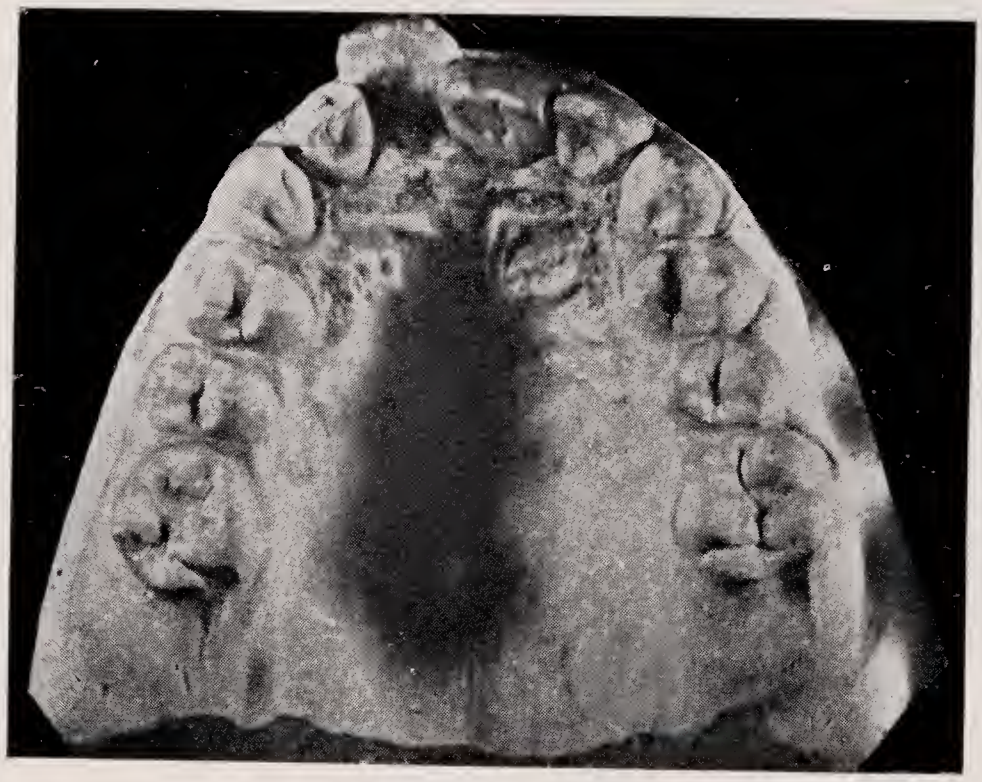


Fig. 19

Figure 19 and 19A show the comparison of this case before and after treatment. The result was obtained in six months without attention from any dentist whilst she was away from home. The gap is practically closed up.. It would probably have been all right if I had taken $\underline{4}|$ out.

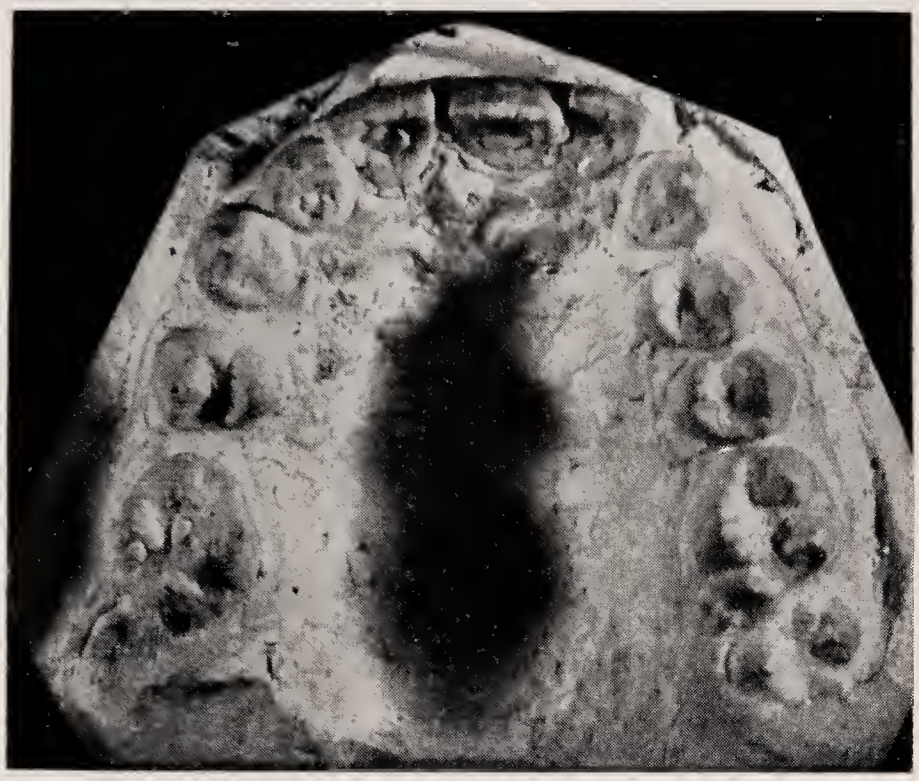


Fig. 19A

Fig. 20

Figure 20 is a Class II case. The canines have not erupted, and the figure shows the view from the back of the mouth and how the lower teeth are biting right on to the hard palate. This was treated by a type of plate designed by Mr. Visick. I do not know whether he is here or not, but I am sure he would be interested.

Figure 21 shows a vulcanite plate made with four strong half-round stainless steel spurs in front. The first premolars are extracted and a labial bow wire with loops for adjustment passes out through the spaces created by the extractions. The upper incisors are pulled backwards by the labial bow, and there is also an inclined plane on the plate to press the lower incisors downwards and forwards.

Fig. 21

Figure 22 shows the back view of the mouth, again with the lower incisors depressed and well off the hard palate.

Figure 23 is a diagrammatic view of the action of the Visick plate. A is a vulcanite plate with spurs in front ; B is a labial bow which can be pulled backwards by tightening the loops. The patient bites up and that pushes the lower teeth forward and depresses them. The spurs must be bent upwards in order to take the pressure of the plate off the hard palate, so that all the force of the bite is transmitted to the edges of the upper incisors and shortens them. The angle to which the teeth occlude or bite on the wire is very important. They must bite about at C, so that the upward pressure of the inclined plane pulls the upper teeth lingually. Each time, therefore, that the patient comes for adjustment the spurs are bent upwards and adjusted so that the upper teeth bite on that part of the spur which is inclined backwards and downwards. After the plate has been worn for three weeks or so the teeth will have moved backwards, then the spurs are shortened and bent up. It is constantly necessary to reduce the vulcanite on the lingual side, because room must be made for

Fig. 22

the teeth to move backwards. The adjustment, therefore, is made by cutting vulcanite away, shortening the spur wires, bending them up and tightening the loops on the labial wire. Children must be instructed to eat with the front teeth because the molars do not quite touch. This allows the molars to erupt a little more and thus helps in opening the bite.

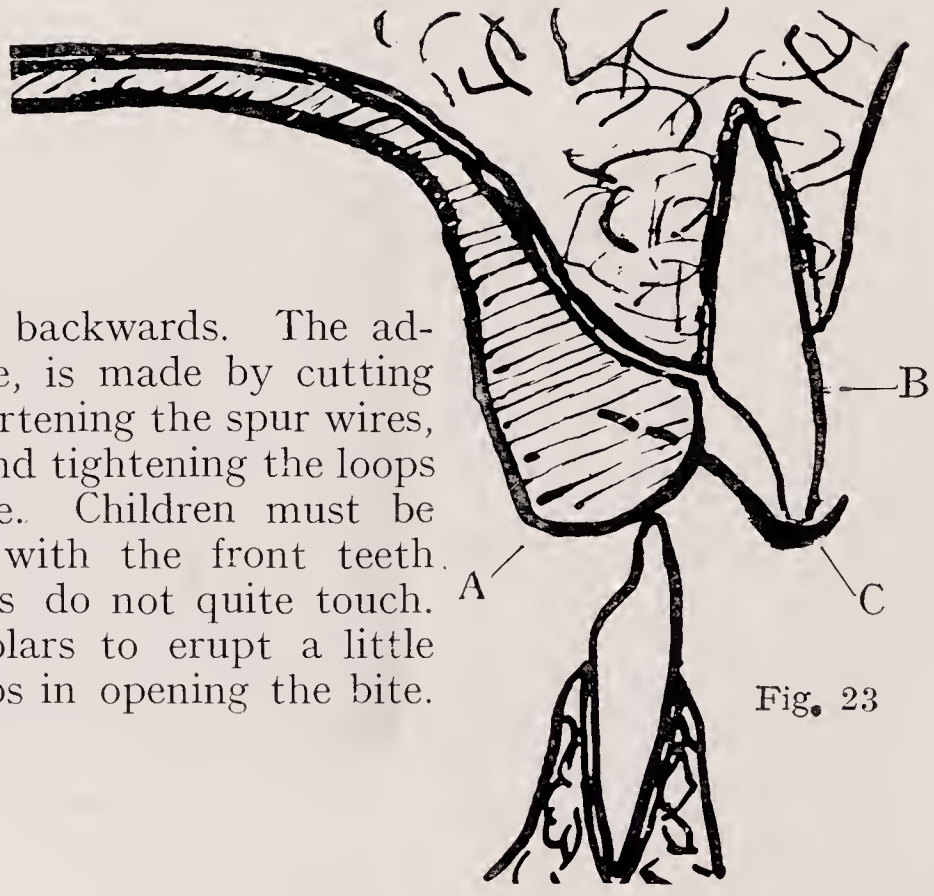


Fig. 23

Fig. 24

Fig. 25

Fig. 26

Figure 24 is a Class II case—distal occlusion of the lower molars —an early thumb-sucker. Notice particularly the extreme space between the upper and the lower incisors. The lower lip is hidden by the upper teeth and the expression of the child is entirely spoilt by the upper teeth protruding in that fashion. The overbite was reduced entirely by wearing a Visick plate for three months.

Figure 25 shows the lower teeth not biting on the hard palate, and it is easy to move the front upper teeth backwards since there is no obstruction. After three months the upper first premolars were extracted and a stainless steel upper bow inserted labially.

Figure 26 shows the passive position of the bow. The bow is arranged in the tubes on the molars so that its passive position is at the junction of the lower and middle third of the crown. The bow is sprung downwards and pushed backwards at the same time, so that the four hooks clip the incisive edges of the four upper incisors. The upward pressure will shorten those teeth.

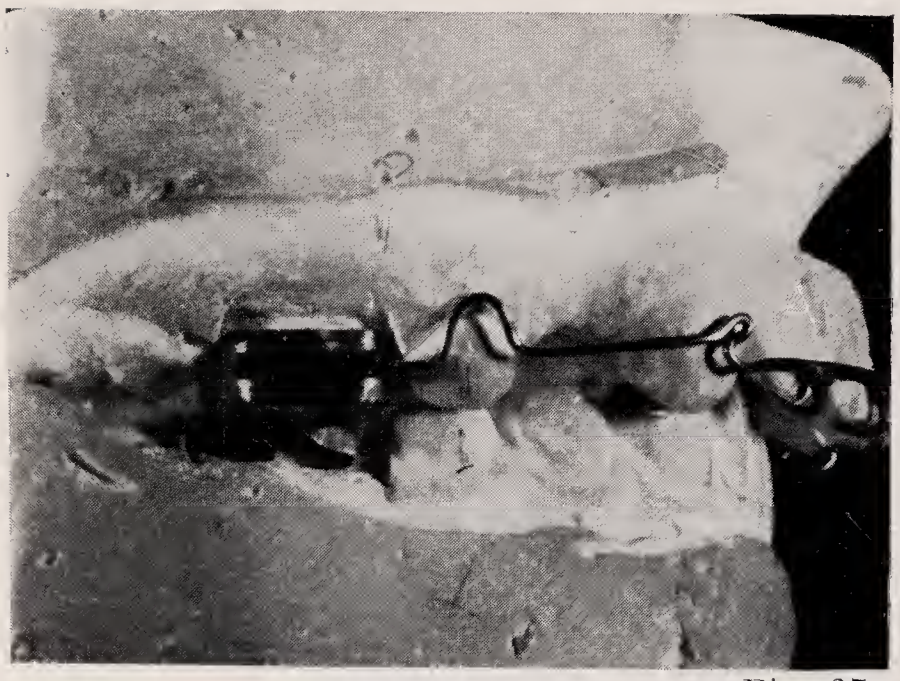


Fig. 27

Fig. 28

Figure 27 is a side view of the same case. The loop finishes at a point which allows the bow wire to be pulled a limited distance. A is an intra-maxillary hook ; a rubber band over this hook and also over the buccal tube on the molar band pulls the whole bow backwards, pulling the upper incisors with it, but they are also shortened, since there is an upward spring on the front of the wire. This tends to tilt the molars backwards and gives stationary anchorage. The molars cannot tilt forward because of this spring. At each visit it is important to see that there is actually an upward spring in front. As soon as the bow has moved distally until the loops touch the tubes the action ceases. It is then necessary to close the loop up to shorten the wire.

Figure 28 is an occlusal view of the same case, showing the little hooks on the incisors. Intermaxillary traction may be used if thought necessary by putting a rubber from the intermaxillary hook on to a spur on the band of the lower molar. The lower lingual wire stabilises the molar and slightly pushes the lower incisors forward.

Figure 29 shows the result; the upper front teeth are now touching the lower teeth; the lip cannot get underneath the upper teeth and the incisive bite is quite normal.

Figure 30 is the profile of the patient after treatment. By the way, in my early days I did not photograph all my patients to start with, and that was a great mistake. Quite a number of photographs in this series have been obtained from parents,

Fig. 29

Fig. 30

Fig. 31

and were taken several years before I started treatment, so if you think that the photograph before treatment shows a young child and the final photograph shows a much older one, do not think that it is because the treatment has been going on for a long time. It is because I did not photograph them at the start.

Figure 31 is another photograph taken some years before I started treatment. It is enlarged from a little snapshot which the parents lent me. Notice the condition of the teeth; the four incisors are well over the lower lip; possibly the lower lip is rather short.

Fig. 32

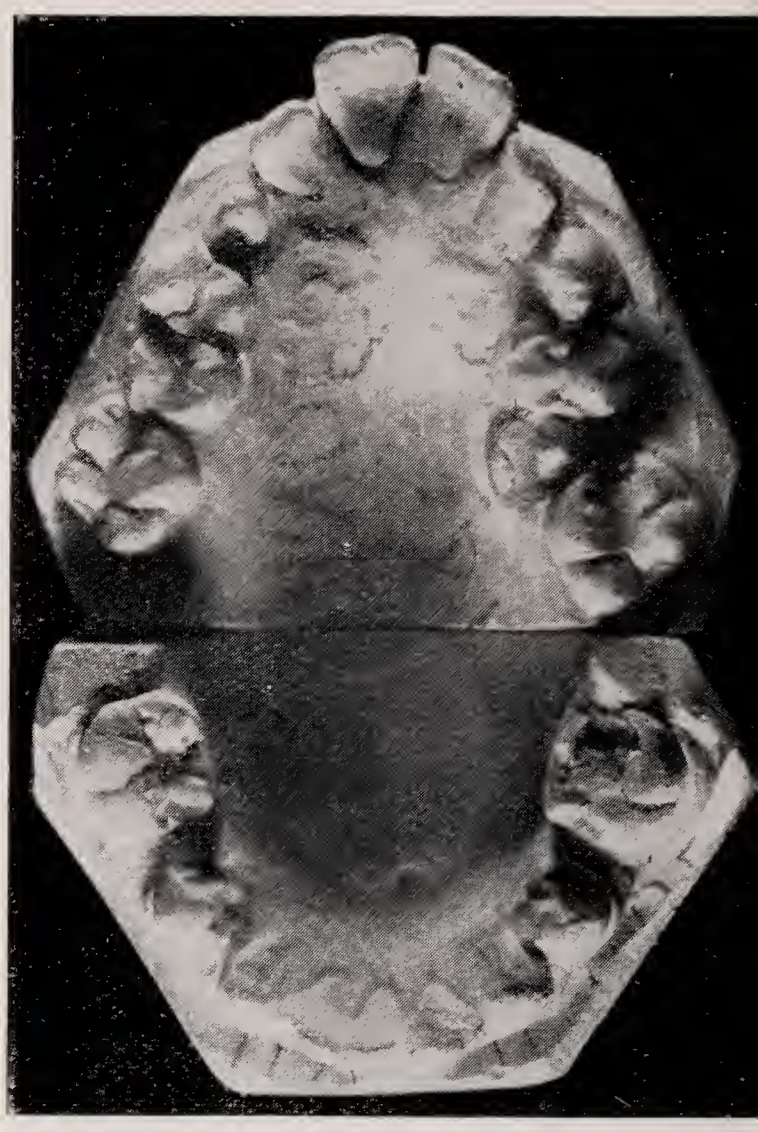


Fig. 33

Figure 32 shows the models. The lower lip is under the upper incisors, which are forward and the lower incisors back. X-rays show that $\overline{|\ 2\ 5}$ are congenitally absent, or possibly extracted by some unknown dentist when the deciduous teeth were taken out.

Figure 33 gives an occlusal view of the two models. It is a case of balancing up by extractions before treatment is started. In the lower jaw 5 | does not show but it is present, and every effort must be made to get it to erupt. As the lower jaw is too small it is desirable to increase its size ; in the upper, room is greater ; the molars are normal. I decided to take two premolars out in the upper, as there were already two units missing from the lower, so that would balance up.

Figure 34 shows the results after nine months' treatment.

Figure 35 is the profile after nine months' treatment.

Fig. 34

Fig. 35

Fig. 36

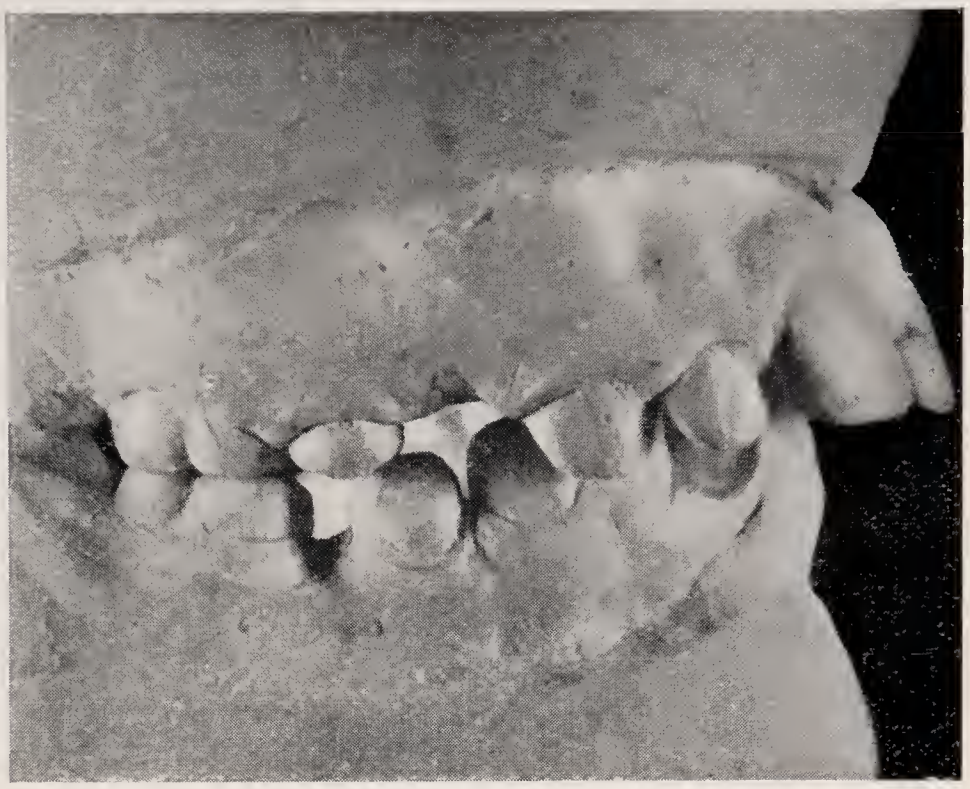


Fig. 37

Fig. 38

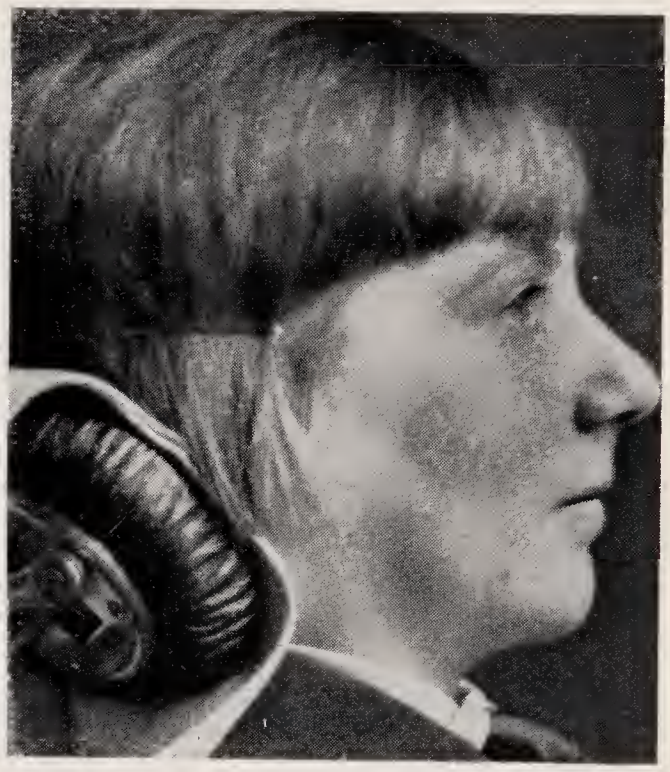


Fig. 39

Figure 36 is an early photograph of another very similar case, only here, when presented, there were two lower teeth already extracted instead of being congenitally absent.

Figure 37 shows the teeth protruding in front. $\overline{5 \mid 6}$ were extracted before the patient came to me; as a result the lower front teeth have fallen back and the lower lip now passes lingual to $\underline{21 \mid 12}$. I had to take some upper teeth out, and this shows the extraction of $\underline{4 \mid}$. The other side is the same.

Figure 38 shows the condition to date. The upper incisors are retruded and the lower aligned quite nicely. The teeth are well inside the lips and the profile (*Figure* 39) is quite good.

Fig. 40

Fig. 41

Figure 40 is quite a different type of case. 1 | 1 centrals are very much in front of 2 | 2 and the space is not quite wide enough for 1 | 1. There is a tremendous incline, almost 45 degrees of 1 | 1.

Figure 41 shows the condition of the mouth at the time of starting treatment. It is a Class II case, and again we extract 4 | 4.

Figure 42 is a diagram in which I have tried to show the forces which have brought about the correction. It is a very important diagram to follow, and if those who do not already know it will follow it, they will find it very useful. There are pinch bands cemented on the two upper centrals, carrying D tubes vertically on the labial surfaces ; the lower picture shows a D tube. The stainless steel wire is very thin and delicate, being only 0.5 mm. thick. It is bent so as to fit accurately into the D tube, and the method of fastening it is to thread a soft ligature wire through the loop at the top, bring each end round the back of the bow wire and tie it at the bottom. In practice it is pulled quite tight ; the ends are cut off rather long and bent up behind the two limbs of the labial bow wire, where they do not injure the soft tissues. The method of adjustment is as follows : The wire is adjusted so that its passive position is shown by a dotted line, and when sprung up into the buccal tube on the molar band it will rotate incisors round a horizontal axis about A, so that the incisive edges move lingually. The roots tend to go labially, but that does not happen in practice, because there is also an intramaxillary rubber from the hook B, round the back of the tube on the molar band. That rubber pulls the upper central tooth bodily backwards, as indicated by the two arrows c c. The wire has been sprung up from its passive position, so that the downward force thus created tends to elongate the molars, which has an advantage in reducing the overbite, and the reactive upward force shortens the incisor. That is another favourable force. The end of the wire is bent at a good angle so as to give the molar a good tilt forward at the roots, so that the crown is being tilted backwards. This gives it stability and enables

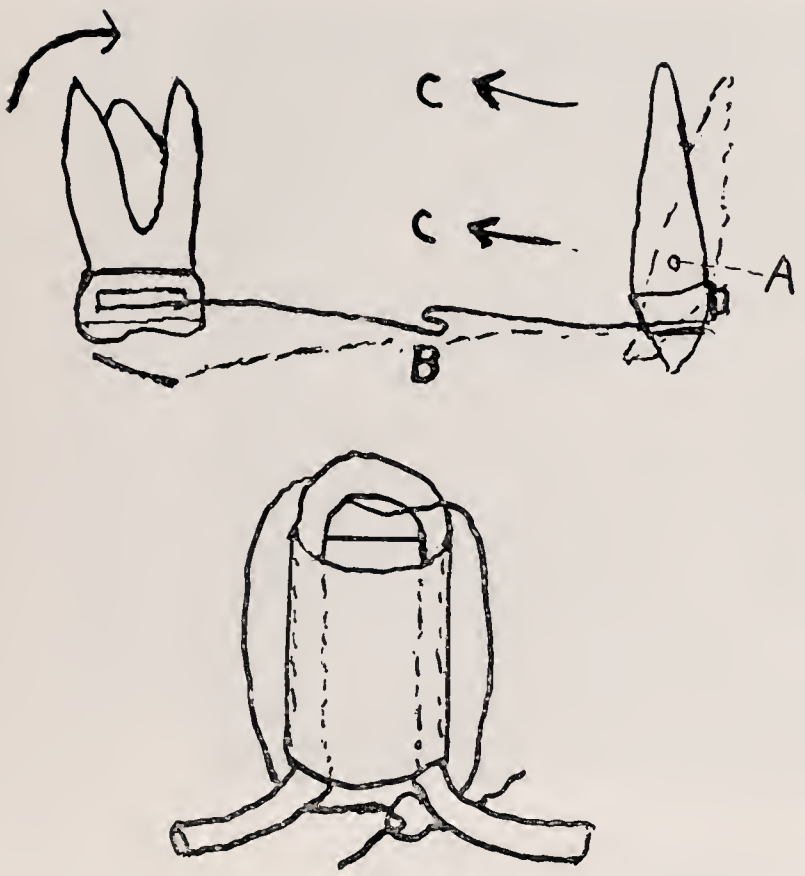


Fig. 42

it to stand the force pulling it forwards exerted by the intra-maxillary rubber and gives stationary anchorage. Every force with the exception of the pulling forward of the molar, is favourable to the correction, and there is practically no movement of the molar if the adjustments are correctly made. It would be impossible to push the bow wire in the molar tube, as the diagram shows. In actually fitting the bow, after it has been adjusted, the ends are passed into the molar tube first and the loops are slid into the D tubes afterwards.

Fig. 43

Fig. 44

Figure 43 shows the result after fourteen months' treatment.

Figure 44 is a photograph showing teeth well inside the lips. She has now a mouth-screen to wear at night in order to make sure that the position is maintained.

Figure 45 is that of a boy who has fallen down in the schoolyard and broken off half the upper incisor. We all get such cases as the result of accident. The nerve is exposed and he will either have a dead crowned tooth all his life, or it must be extracted. I decided to take it out. The apparatus fitted was very simple; he wore a mouth-screen (*Figure* 46) for nine months, simply a piece of vulcanite made to fit the front of the mouth inside the lips. The method is as follows: occlude the two models, place a piece of modelling wax over the area to be covered, which should be

Fig. 45

Fig. 46

from the front edges of the molars at the sides and as large in front as possible without injuring the soft tissues. Put plaster on top, and when it is set, remove the models and add a little wax in the depression made by the most prominent teeth, so as to spoil the fit and make the plate rock on these prominent teeth. In this way the pressure of the lips is transmitted to these teeth. In three weeks or so the prominent teeth will have moved backwards and the plate will have ceased to rock. It is then necessary to make the plate rock again and this can be done easily by drilling holes in the plate in the desired positions and inserting pieces of rubber about 2 mm. square in the same fashion as the old hickory peg, but rubber is easier and quicker than the peg. After the teeth have moved backwards still more, it may be an advantage to make a new plate in order to get a better fit to the front teeth and to allow of the use of shorter pegs, and also to

Fig. 47

Fig. 48

enable the lips to assume a more natural position. *Figure* 47 shows the result after wearing a mouth-screen only at night for fifteen months. You see that the central is missing, but I think that the result justifies the extraction.

The next case serves as a warning to dentists who have patients referred to them for extraction by the orthodontist. On the visit the four first molars were found to be quite unsavable — decayed almost down to the gum. I therefore sent the case back to the patient's dentist, asking him to remove the first four permanent molars. While the patient was under the anæsthetic the dentist said : " I'll take all the deciduous teeth out as well." *Figure* 48 shows the condition when the case was referred to me. Later I found I had nothing to work on. However, I put a screen in, as in the previous case, to be worn at night, and the improvement, as shown in *Figure* 49, is very marked. The premolars are now erupting in almost normal occlusion. This is just to illustrate what a tremendous force a mouth-screen has and how useful it may be in certain cases. It also prevents mouth breathing.

Fig. 49

Fig. 50

Figure 50 is a case that baffled me very much, and I should be glad to hear the opinion of some of the senior members on it. Why is $\underline{\overline{1}}$ short? It looks very simple, and as if $\underline{\overline{1}}$ is impacted owing to the converging crowns of $\underline{2}$ and $\underline{\overline{1}}$. $\underline{3}$ is just lingual to $\overline{3}$, so I moved $\underline{3}$ labially and fitted an upper bow anchored to eight or nine teeth and succeeded in moving all the anchor teeth (*Figure* 51), but $\underline{\overline{1}}$ did not come down. This baffled me very much. Then I discovered that the child always bit a pencil when she did arithmetic. No apparatus can combat the force of a bite on a piece of hard wood like a pencil. I obtained the mother's and child's promise that she would not go on biting her pencil; I took all the apparatus off and in a little while she got out of the habit. The anchor teeth very nearly returned to their previous positions and still $\underline{\overline{1}}$ did not erupt further, although there was plenty of room. An X-ray shows that $\underline{\overline{1}}$ has a straight root.

Fig. 51

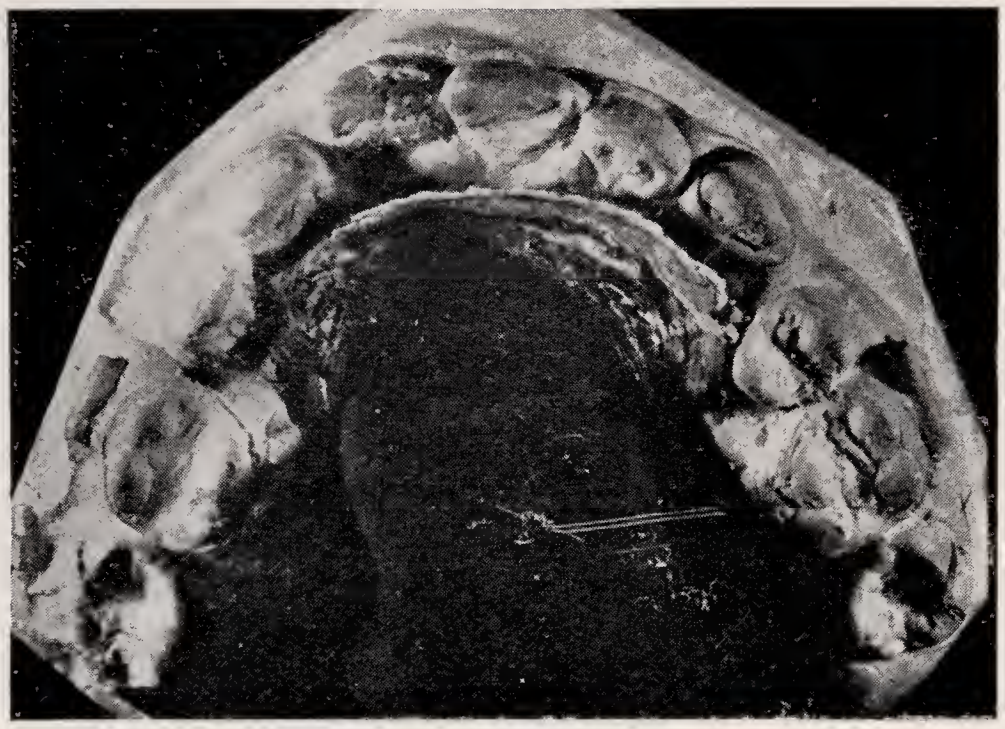


Fig. 52

The conditions were apparently very favourable for it to erupt, but still it did not. Then I noticed a little thing like a cherry sticking out of the mouth ; it was the tongue pushing out under the incisive edge of $\underline{1|}$ when the child was not thinking of it. I am convinced that the tongue is now the cause of that tooth not erupting, so I made an occlusal plate (*Figure* 52) with a flange arranged lingually, which prevented the tongue from protruding into the space where that tooth requires to erupt. I have taken very careful measurements over a few months, and the tooth is starting to erupt by natural forces since the tongue has been screened away. I will report later on, but I have hopes of getting the tooth down by removing the forces which held it up ; first the pen or pencil, and then the tongue.

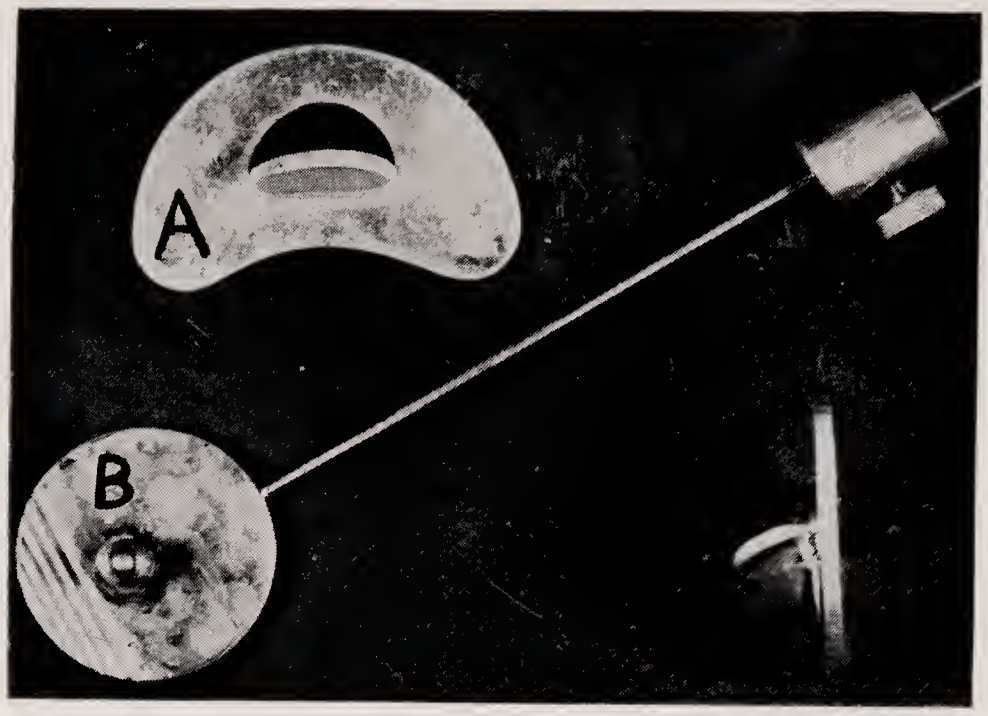


Fig. 53

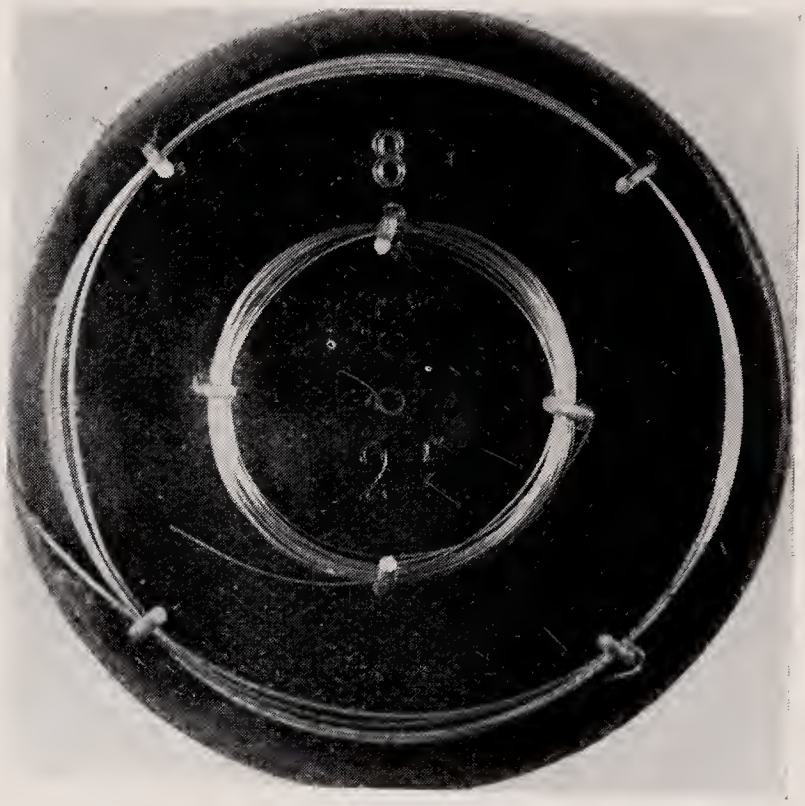


Fig. 54

Figure 53A.—I think that Dr. Friel invented this aluminium disc. He calls it a " reminder." When the upper teeth have been moved back sufficiently to allow the lower lip to pass in front of them, it is very important to cure any lip-sucking habit which might bring about a relapse of the teeth. If the child is reading a book or not talking, and when there is no reason why she should not wear it, she grips this aluminium disc between the lips. It becomes a habit, like smoking a cigarette ; I have tried it and quite like it. It makes you breathe through your nose and is very light and easy to hold, and quite a good thing to wear simply as a maintenance device after the teeth and lips are in normal relation.

Figure 53B is an appliance by which, by moving the weight along, you can test the strength of the lips. Very often children cannot hold it with the weight entirely off, but after a time and with exercise they will hold it with the weight at the end.

Figure 54.—Those of you who have been using stainless steel wire will find that it is difficult to keep tidy in a drawer. It wastes

so much time having to wind the coil up again each time you cut a piece off. This is a most useful form of wire holder ; it is just a piece of wood with four bent screws put in and the wire coiled inside them. When you want a bit off you unravel sufficient, cut it and the rest remains intact. The device keeps the wire tidy and prevents it from getting kinked, and also allows it to be stored flat in the drawer.

Fig. 55

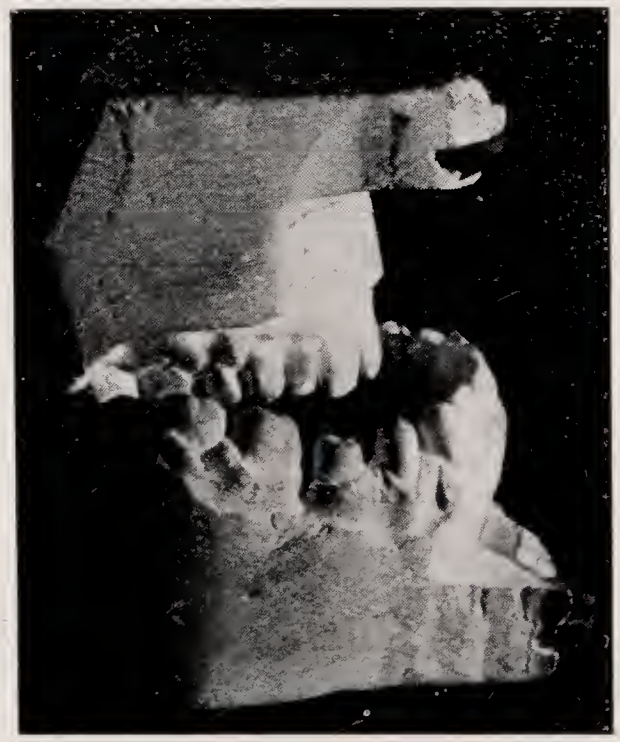


Fig. 56

Figure 55 is a Class III case I am showing for the benefit of those who have not seen it. A man, aged 28, had his lower incisors 17 mm. in front of the upper incisors.

Figure 56 is the condition (right side) when he first attended. The model is articulated on an articulator.

Fig. 57

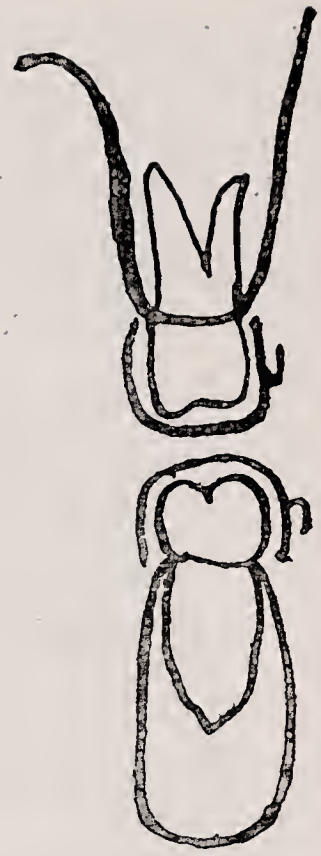


Fig. 58

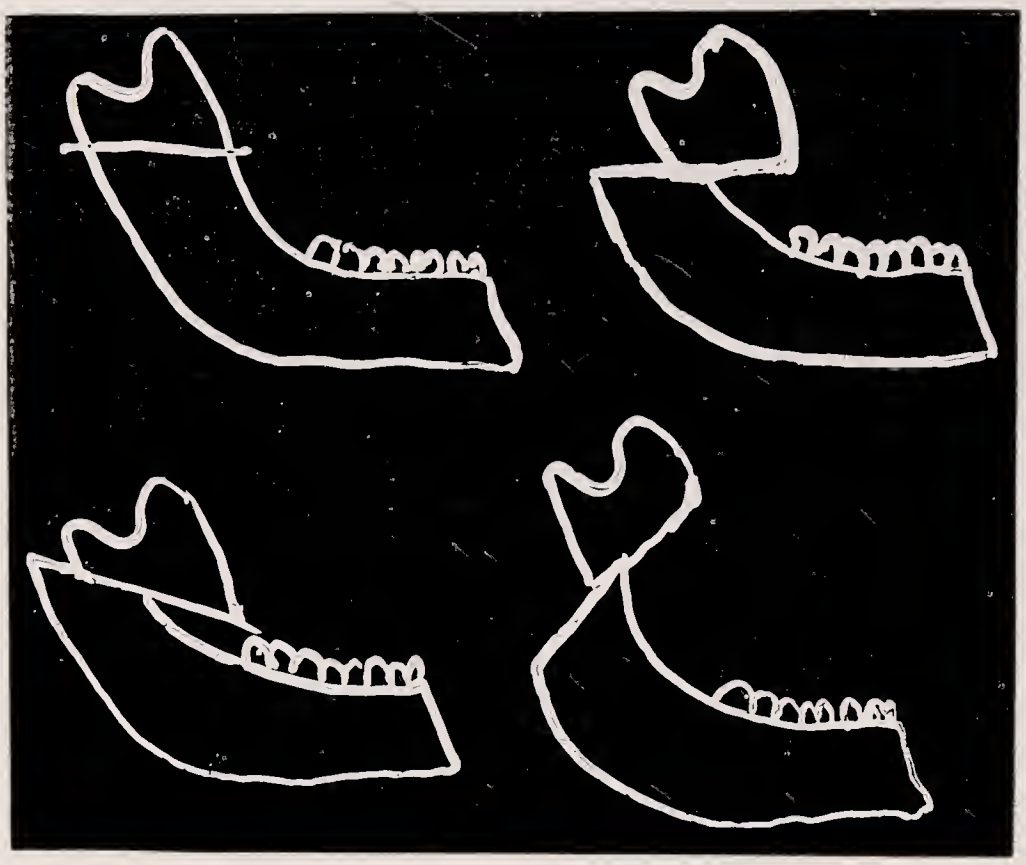


Fig. 59

Figure 57 is a front view. The only points of occlusion are just in the molar region, one spot on each side. He could hardly masticate and was almost demented and his speech was not good.

Figure 58 shows a sketch of the silver splint that was made. A trough of silver was cast for the upper and for the lower teeth. Nearly all the teeth were present and in very good condition, which was remarkable, considering that they were mostly functionless. Several small hooks were soldered to each splint and the splints were cemented on the teeth the day before the operation. Mr. G. E. C. Simpson of Liverpool sawed each ramus through below the sigmoid notch and above the mental foramen, leaving the arteries and nerves intact.

Fig. 60

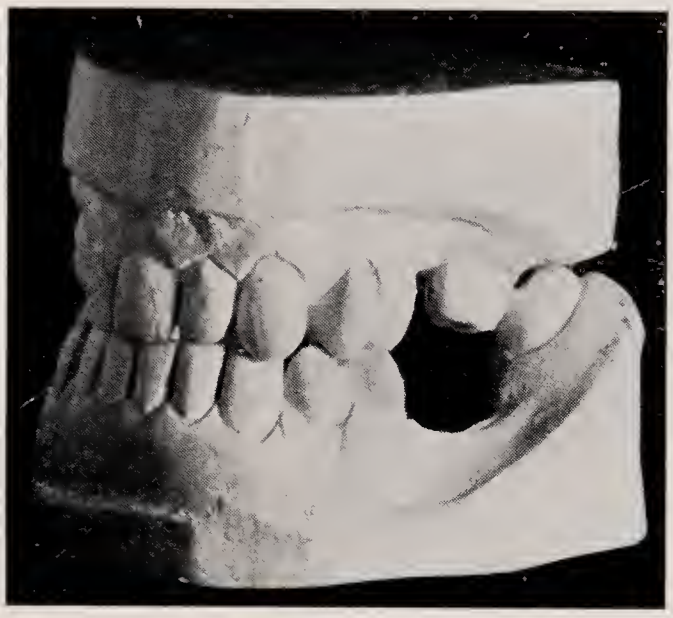


Fig. 62

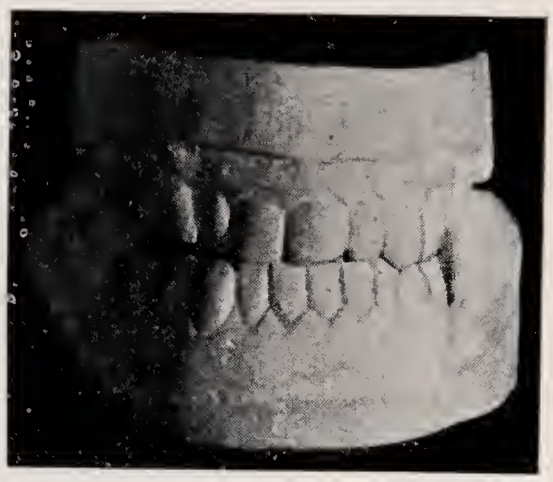


Fig. 61

Figure 59 shows the result of making the saw cuts at different angles. In this case we wanted to lengthen the rami, so they were sawn backwards and downwards.

Figure 60 shows occlusion (right side) after the jaw had been pushed back.

Figure 61 is the front view. *Figure* 62 (left side).

It might be interesting just to say a few words about the operation itself. It was all done from the outside ; an aseptic operation was carried out without a spot of blood entering the mouth. A small incision was made about half an inch long, the position being ascertained by palpation and X-ray examination (just a slight cut to get through the skin). The facial nerve is very near, and there is a danger of severing it. A blunt instrument was pushed up to the posterior border of the ramus (Hilton's method), the periosteum was cut and a periosteal elevator was pushed along the deep surface of the ramus. Directed by that elevator, a small saw was introduced, and the bone was sawn from within outwards—not quite through, because the parotid gland and the facial nerve are on the outer side of the bone. When it was nearly sawn through, a chisel was inserted and the division was finished with about two knocks. The bone was, therefore, cut through from inside outwards without any injury to the facial nerve. The other side was done the same way. The lower jaw was pushed back and wired to the upper jaw with tinned copper wire, gauge 24. The patient was left with the lower jaw fastened to the upper for six weeks ; he was fed through a glass tube through the gap left by the previous loss of a molar. If the gap had not been there we should have had to take the tube round the back. The bony union was quite good but there was poor occlusion as the lower teeth had never been in

Fig. 63

natural contact with the upper teeth. A little articulating by grinding, however, brought about the result shown in *Figure* 63, which is of the profile after the operation.

My thanks are due to Prof. W. H. Gilmour, Mr. H. Bernard Concanon, and Mr. L. Parsons for help in preparing this address, and to Mrs. Lindsay for operating the lantern.

Discussion.

Mr. A. L. Packham, in proposing a hearty vote of thanks to the President for his presidential address, said that it would not be difficult for any member to imagine the labour which Mr. Watkin had put into its preparation. One and all would without any hesitation support the motion. The President had, continued Mr. Packham, given a demonstration of what could be done by a method well known amongst orthodontists : a combination of extraction and appliances. Every member would learn a great deal from the numerous cases that had been shown and the ingenuity which had been applied in some of the methods of bending the stainless steel wire and using the reciprocal and interacting forces. Most of the members there knew, but for the benefit of those who did not, Mr. Packham added the personal note that the President came month after month all the way from Liverpool to attend the society's meetings. He must be a very eager member of the society, for this practice showed an extreme degree of keenness. The President had referred charmingly in his address to the efforts of Mr. Samuel and Mr. Badcock to induce him to become a member, but most members would agree that the society was in its turn indebted to those two gentlemen for securing one who had proved such an energetic member and was going to prove an even more energetic President.

FURTHER CASES ILLUSTRATING THE ILL-EFFECTS TO THE UPPER ARCH OF THE LOSS OF LOWER TEETH.*

By HAROLD CHAPMAN, L.D.S.

CASE I. Female. Age 19-0. Class I.

At age 16-6, $\underline{|\ 1}$ was extracted because it was badly rotated: from the history, probably one of the approximal surfaces presented labially. Since the removal of this tooth the patient thinks the upper laterals have become more unsightly, particularly the left one, which rests on the lower lip. It would seem that this case, originally, was an example of some contraction of both arches, represented in the lower by severe rotation of one lower incisor,

Fig. 1

and in the upper by labial occlusion of the laterals, but not sufficient to direct attention to it. In all probability the loss of the lower tooth has allowed the lower arch to become smaller (and the alignment to remain good) and when it contracted the upper one contracted also, but as there was no loss of a tooth, a crowding—in this particular case an increased crowding—is to be expected (particularly if there is any facility for this to occur, e.g. incorrect approximal contact as in this case between 2 1 | and $\underline{|\ 1}$ 2), and is shown by the increased labio-clination of $\underline{2\ |}$ 2, now sufficient to be unsightly (Fig. 1).

It would be interesting to know if there would have been any collapse of the upper arch had this arch been normal and the approximal contact of all the teeth correct. It would also be interesting to know if a more satisfactory result would have been obtained had an upper lateral been removed when a lower central was taken out, or even an upper central, as was done in a case shown by Mr. A. L. Packham in 1926.† The general condition of the mouth was excellent.

* *Transactions* of British Society for the Study of Orthodontics, 1933.

†Packham, A. L. "A Case Showing Tooth Movement." *Trans.* British Society for the Study of Orthodontics, 1926, page 40.

Case II. Male. Age 14-0. Class II. Division 1, an almost typical example.

The lower arch is good: the general condition of the mouth is good, except that $\overline{6|6}$ have lost their crowns entirely through caries and only the roots remain, with consequent reduction in the space occupied by the crowns. A typical feature of the case is that 1 | is considerably labial to the alignment of the remaining upper teeth (Fig. 2); the arrangement of the other upper anterior teeth is typical of this malocclusion. The mother reports that the position of the upper central is getting worse. This would only seem to be possible if the lower arch is becoming smaller, which it may quite well be doing as a result of the loss of the crowns of $\overline{6|6}$: the roots of these teeth were removed shortly after the impressions were taken.

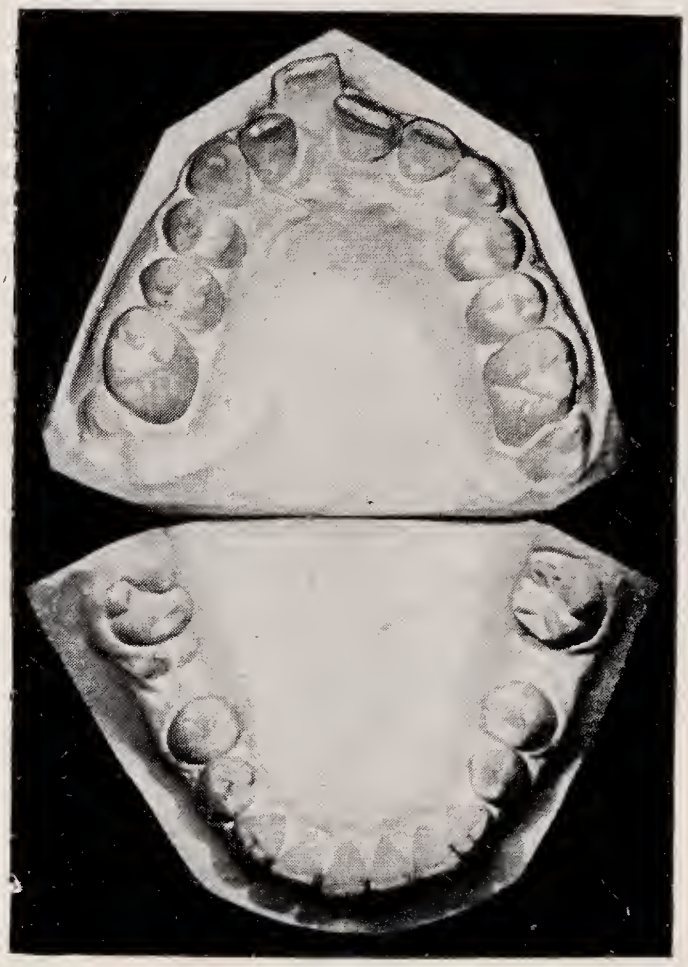


Fig. 2

The President asked Mr. Chapman whether he was doing any treatment for that case, which was very similar to the case of the doctor's daughter which he himself had shown. He would take the upper first or second premolar to compensate to some extent for the loss of the two lower molars, and to restore the balance which was lacking. If he did this he would get an easy result in the next six months.

Mr. Packham thanked Mr. Chapman for showing, by his Communication, in a yet clearer light the difficulties which attended the practice of orthodontics by the extraction of teeth. It had always seemed to the speaker since he had worked on the subject that the practice of orthodontics was extremely difficult in any case; its practice by the extraction of teeth was even more difficult. It was very hard to know what was going to happen after the extractions had been carried out. Even if Mr. Chapman had emphasised that note alone, the society would have learned a great deal from his Communication.

THE PRACTICAL APPLICATION OF STAINLESS STEEL IN THE CONSTRUCTION OF FIXED ORTHODONTIC APPLIANCES*

By Sheldon Friel, B.A., M.Dent.Sc., Sc.D. (Dubl.)

A complete alteration in the basic material used in the construction of fixed orthodontic appliances can only take place after the new material has been tried in actual practice by a number of workers whose technique varies, and after it has been demonstrated that the new material has definite advantages over that which it is proposed to displace, and that when it has disadvantages, these can be overcome.

I have now employed stainless steel exclusively in my practice for the last year in making new appliances, and propose in this paper first to discuss the relative advantages of stainless steel and gold alloys, then briefly to describe the theory and practice of electric welding as applied to stainless steel in the preparation of orthodontic appliances, and finally to explain in some detail the appliances which I use in my work and the technique of their construction. Stainless steel was invented by an Englishman, Brearly of Sheffield, in 1913, and there are now several proprietary brands, varying slightly in their chromium-nickel content. These brands may be divided into two distinct types, the austenitic and the martensitic. The former is stainless at any degree of hardness, can only be hardened by working in the cold state, and is softened by heating or by heating and quenching. It is this type which is employed in orthodontic work. (The martensitic alloys, which are used, for instance, for making cutlery, are stainless only in the tempered state, and can be tempered by heat treatment.) The percentage composition of three of the chief austenitic brands is as follows :—

Firth's "Staybrite." Chromium 18%, nickel 8%, carbon .1%.
Brown Baily's "Anka." Chromium 15-16%, nickel 10-11%.
Krupps' "Wipla" V.2.a. Chromium 20%, nickel 7%.

We now come to a consideration of the comparative advantages and disadvantages of stainless steel and gold alloys. The first and most obvious advantage of the former is the enormously reduced cost. A major item in the cost of running an orthodontic practice disappears for all practical purposes. One pound of steel wire will cost 4*s.* 6*d.* to 8*s.* 6*d.*, according to the diameter, while a similar weight of gold will cost about £145. Next we find that stainless steel has greater tensile strength and greater toughness than gold, both these factors being of prime importance in view of the desirability of reducing to a minimum the size of the appliance in the patient's mouth. It is also found that stainless steel appliances remain untarnished and keep clean in all cases, while those made of gold alloys tarnish in many mouths and are apt to collect debris. The disadvantages of stainless steel for

* *Transactions* of British Society for the Study of Orthodontics, 1933.

orthodontic work lie entirely in the difficulty of working the material by methods employed with gold-platinum alloys. With the latter, joints can be made with hard and non-tarnishing solder, without undue loss of temper, while by the use of heat, appliances can be adapted very exactly to models, and the complete appliances can be tempered by heat treatment. The low softening temperature of stainless steel, on the other hand, prohibits the use of any but a low fusing solder, such as that known as "silver" solder, because the use of the flame in this process causes oxidisation which should be removed; this is a tedious operation and, in the case of complicated appliances, difficult. Again, temper once lost by heat can only be restored by cold working. Adaptation to models by the use of heat is inadmissible, so that great exactness in bending up appliances is necessary. Finally, the hardness of the material, otherwise an advantage, makes it very severe on tools, and particularly on cutting tools.

From this comparison of the virtues and vices of stainless steel and gold-platinum alloys, it appears that if a really satisfactory process for uniting steel parts were available, that material would have outstanding advantages, and I am setting before you an account of what seems to me, after a year's experience, such a process—electric welding.

In general terms, welding is "the uniting or joining together of two pieces of metal when raised to a great heat," and in the form of electric welding here described that heat is generated by the resistance of the parts to be joined to the passage of an electric current; hence the name, resistance welding.

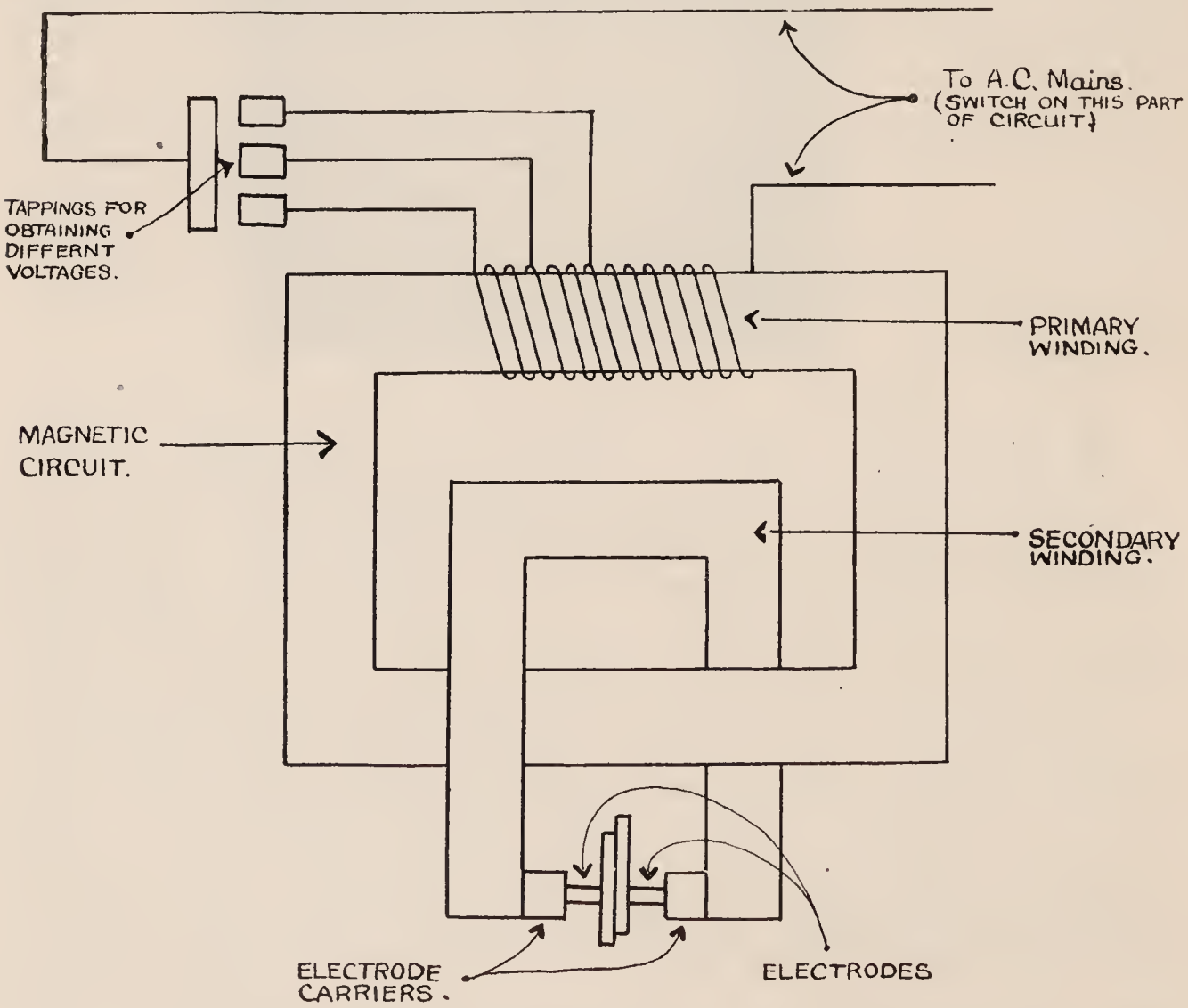


FIG. 1.—Diagram illustrating electric circuits of welding apparatus. Adapted from Wilson's "Electric Welding."

As many points in the technique are governed by the electrical conditions, it is useful to understand something of the theory of the process. It is simply that the passage of a current through any circuit generates heat, and that, since in any part of the circuit the heat varies as the square of the current multiplied by the resistance, the greatest heat will be at the point of greatest resistance. Keeping this in mind, we can easily understand the practical application of it in the apparatus.

Fig. 1.—The first requirement is a heavy current, that is, a current of high amperage, and to get this we have in the welder a static transformer, into the primary coils of which the current of high voltage (100 volts to 250 volts A.C.) which is ordinarily available is fed, with the result that a low voltage current of high amperage is induced in the secondary circuit. For our purpose this voltage will be two volts or less in the British machine and up to four volts in the Belgian machine, and the amperage about 500-750. With the primary circuit, our only concern is that it requires to be wound to suit the voltage of the user's supply, and that a variable tapping provides a convenient control of the welding voltage.

Conditions in the secondary circuit, in which the welding is done, are more important to examine. It consists of three parts—the secondary winding of the transformer, the electrodes and their carriers, and the pieces to be welded. Keeping in mind that the heat will be highest at the part of the circuit where resistance is highest, it is obvious that we require that the resistance in the first two of these should be very low compared to that in the third, and in a properly designed welder this is the case. The function of the electrodes is to provide a convenient means of bringing the current to the right point for passing through the material to be welded.

Considering now what makes the resistance high in the third part of the circuit, we find that two chief factors operate, the comparatively high natural resistance (low conductivity) of stainless steel, and the smallness of the path open to the current.

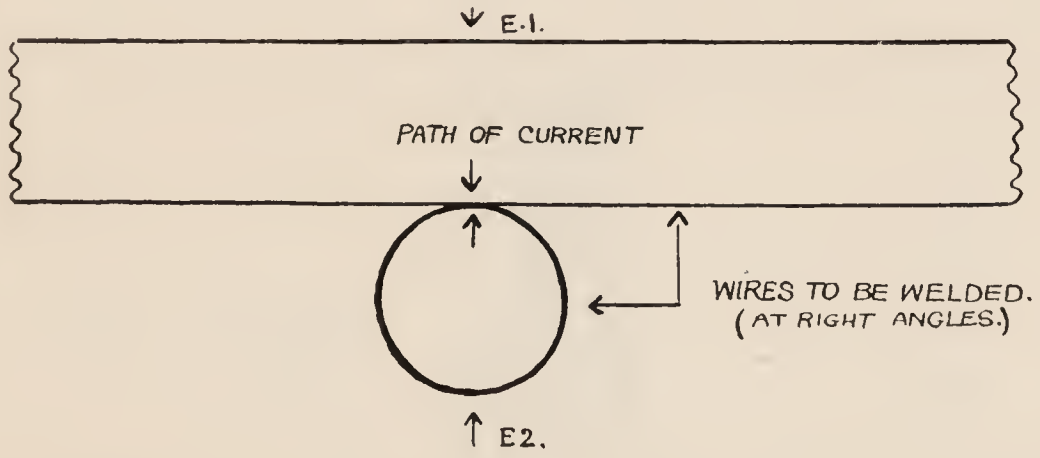


FIG. 2.—Diagram showing path of welding current between two pieces of wire to be welded.

In *Fig.* 2, if the two wires are arranged in an electric circuit in such a way that current must pass from one to the other, it is obvious that its path, the point where they touch, is very minute, and so offers an extremely high resistance compared to the thick electrodes of high conductivity material. This means that the

heat at that point will be correspondingly high, with the result that the surfaces in contact will fuse, and if there is pressure on them, will unite. There is an additional factor here helping to concentrate the heat at the one point, namely that resistance is highest at the surface of the material, due to oxidisation.

We have to take account of three other factors influencing conditions in the welding area. First, conduction of heat. If current continues to flow through the wires the heat will spread from the contact points, resulting in softening and eventually deformation of the wires. Obviously, then, current should only flow for sufficient time to allow the surfaces to fuse. But that time will depend on the weight of current flowing, so we get the rule *to use the maximum current for the minimum time.* In practice, there is a limit to the quickness even of an automatic switch, but the rule should be observed as far as that limit will permit.

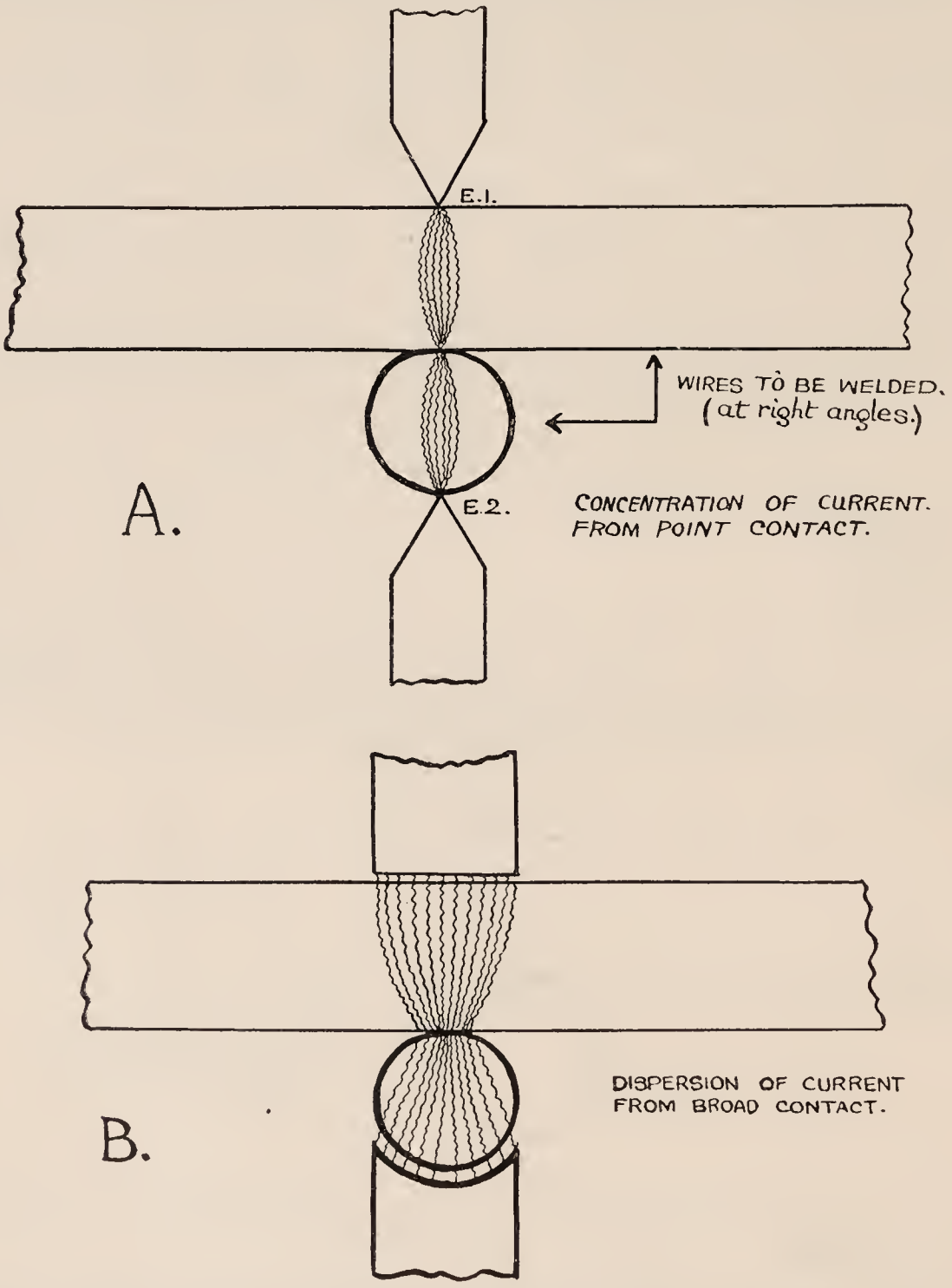


FIG. 3.—Diagram showing path of current between (*a*) pointed electrodes, (*b*) broad contact electrodes.

Secondly, it has been stated above that pressure completes the weld, but to avoid deformation of the heated metal that pressure should be kept to a minimum. (In the British Insulated

Cables Ltd. welder the amount of pressure is exactly regulatable.) Pressure also requires to be maintained until the weld has cooled, in practice a very short time.

The third factor in the welding area is that the way in which the electrodes make contact with the wires has a considerable influence on the nature of the weld. The place to apply the electrodes is at E1, E2, Fig. 2, immediately opposite the contact points, as not only can we then apply pressure through the electrodes, but we have the current passing through and so heating the minimum of high resistance material. In addition, the area of contact is important.

Fig. 3, A and B, show the paths of current flowing through a joint from pointed and broad electrodes respectively. With pointed electrodes the current is more concentrated, so that for the same current and time we get a greater heat and a better weld ; and if we were always welding parts of equal section we would always use pointed electrodes, the actual shape of the point being largely governed by the mechanical strength of the electrode material. It will be noted that where contact occurs between electrodes and parts to be welded, conditions of high resistance occur, so that there is some heating of the surface, but it is less than between the two parts owing to the higher conductivity,

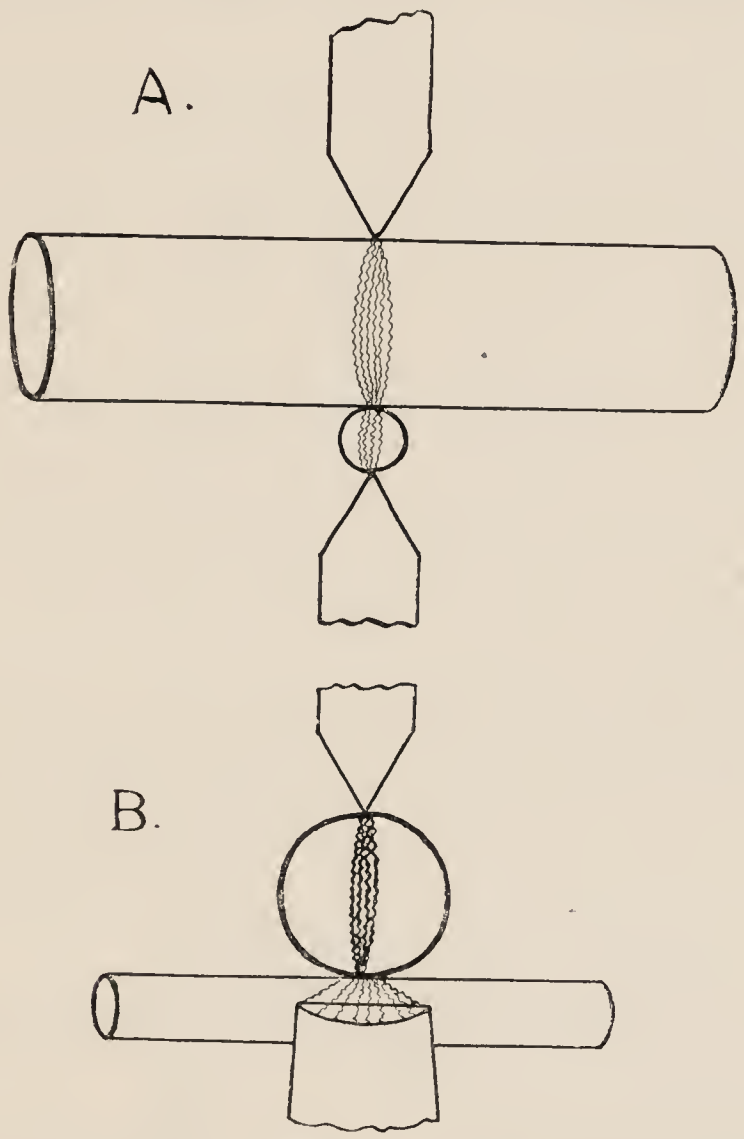


FIG. 4.—Diagram showing the effect of (*a*) two pointed electrodes on weld between wire of widely differing section, (*b*) one pointed electrode in contact with thick wire and broad-grooved electrode in contact with thin wire.

both of electricity and heat, of the electrodes. To keep this heating to a minimum it is necessary that the electrode points should be free from oxidisation. But the different conditions

existing when two parts of widely differing sections are to be welded require some modification of this contact form. In *Fig.* 4, A, an example of this sort is shown. The area of a thin wire fuse in making the weld is in any case proportionally greater than in a thick wire ; also for a given current welding temperature will be reached in a shorter time, so that by the time the thicker wire has reached welding temperature conducted heat will have softened the whole of the thin wire, allowing it to deform under the pressure. But if we apply to the thin wire an electrode that makes with it a larger area of contact (Fig. 4, B), the current will be more dispersed, the resistance less, and the time taken to reach welding temperature consequently equalised with that of the thicker wire.

These are the extreme conditions, and the contact areas required for other kinds of joint are readily deducible from them.

It may be useful to point out that it is for joining two relatively thin parts that the voltage control is required, and for the reason that the dwell of the switch is so long, even at its minimum, to fuse excessively the materials with the full current. The reduced current requires a longer time to achieve welding temperature, and so brings that time within the compass of the switch.

It is to be noted that the input current for a welding apparatus of ordinary type must be alternating. To use direct current from mains a convertor is necessary. Batteries of the nickel-iron type have been used for some apparatus. I have no experience with these. From the theoretical aspect, battery operation appears to suffer from lack of amperage, unless a very large and expensive battery is used.

Some practical features in the design of the welding apparatus are of importance. The controls should be such that the hands are left free. In the British Insulated Cables Ltd. welder this is achieved by the use of one pedal, which first closes the electrodes on the parts to be welded, then, on further depression, operates the switch. The two welders of which I have had experience are :—

1. That designed by Charlier of Belgium (and supplied by the Produits Dentaires " Belgica," Brussels).
2. That supplied by the British Insulated Cables Ltd., Prescott, Liverpool.

The Belgian machine that was shown at the second International Orthodontic Congress in London does not supply sufficient current for all the purposes that I required. The latest model is, I believe, more powerful. My machine is worked by two pedals. One of these pressed acts against a spring and opens the electrodes ; the second pedal works a trip or trigger switch. The whole outfit is complete with table.

Fig. 5.—The British machine is very compact, but has to be fitted on to a table or bench. It has only one pedal. In this case the electrodes are apart and are brought together by pressing the pedal a certain distance. As the pedal is pressed further it brings into action the trip switch. With further pressure of the pedal the switch goes off, but the pressure between the electrodes remains. The electrodes show a distinct improvement over the plain copper electrodes. They are made of some copper alloy which stands up five times better than does the plain copper.

The technique that I employ is probably not original, but a modification of that used by many orthodontists. The amount of current used in each operation will be stated in brackets as one of three strengths or speeds : (High), (Medium), (Low).

This portion of the paper will be under the following heads :—

1. Plain bands or rings. 2. Arches or bows.
3. Tubes, horizontal and vertical. 4. Springs.
5. Labial extensions from lingual arches.
6. Hooks for intermaxillary elastics. On molar bands and arches. 7. Materials used.

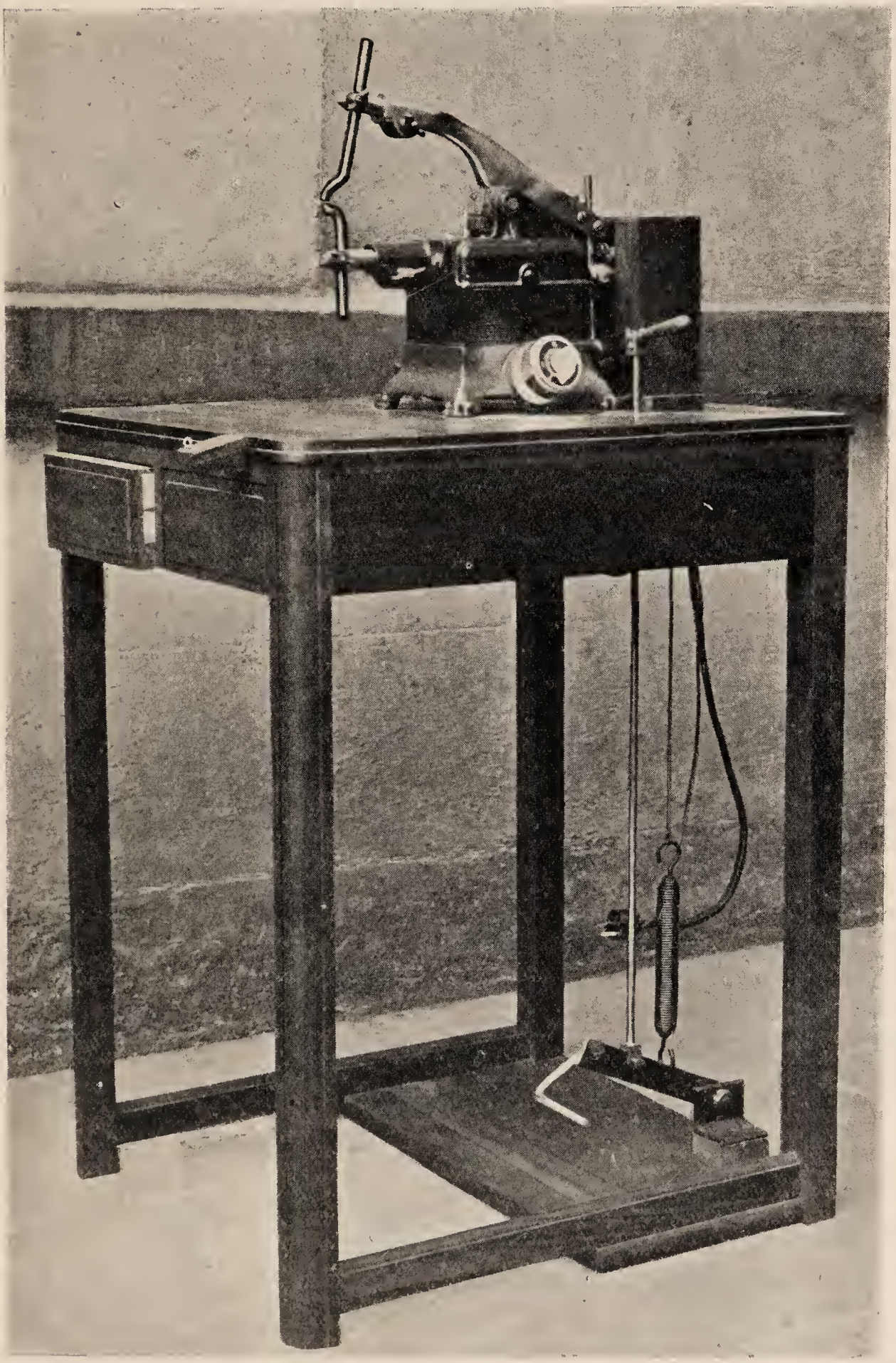
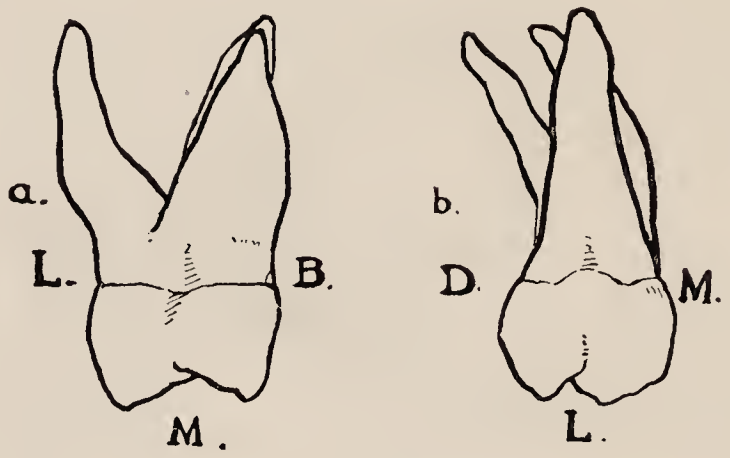


FIG. 5.—Welder supplied by the British Insulated Cables Ltd. Pedal closes electrodes and operates trip switch.

1. Plain Bands or Rings.

Many papers have been published on the making of plain orthodontic bands for molar teeth. They all recognise the difficulty of making a collar that will fit the cervical margin of a tooth, and they all describe their different methods of trying to overcome this difficulty. The stability of an appliance depends to a large extent on the fit of the molar bands. Not only, however, is the stability of the appliance at stake, but also the health of the gingival tissues. I will now describe my own technique. The procedure is slightly different in making bands for upper and lower first permanent molars owing to the difference in shape and inclination.



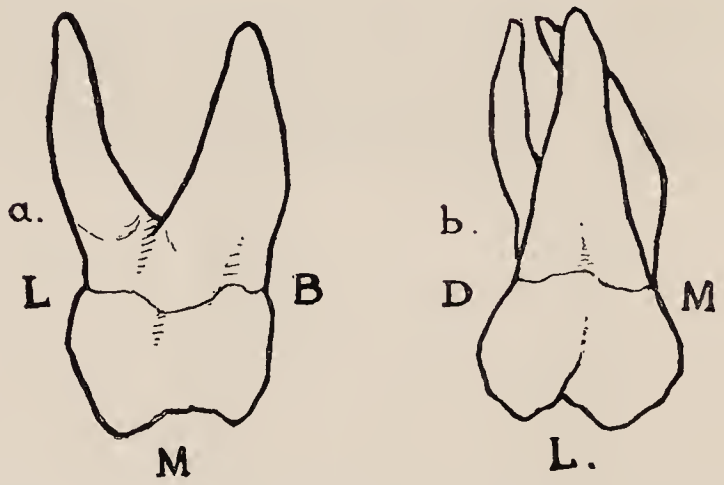


Fig. 6.—Drawing of two upper left first permanent molars, (*a*) viewed from medial aspect, (*b*) viewed from lingual aspect.

Fig. 6.—*The upper molar,* as viewed from the medial or distal aspect, show the buccal and lingual surfaces to be inclined upwards and outwards relative to the long axis from the coronal margin. The inclination on the buccal side ends about 1 mm. to 2 mm. crownwards from the enamel cementum junction, while above this point the surface is inclined in the opposite direction. On the lingual side the main inclination ends further away from the

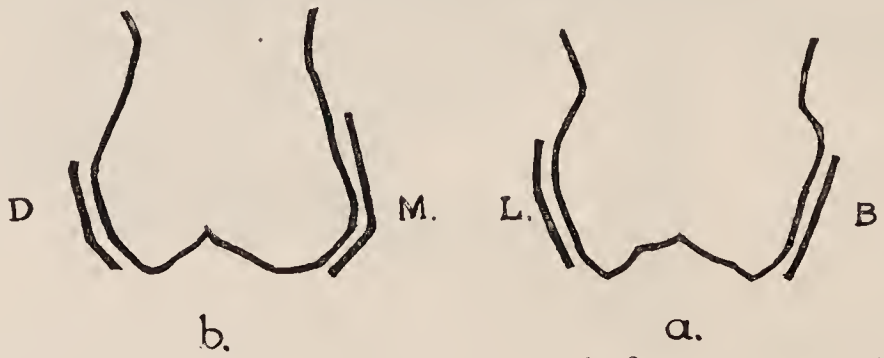
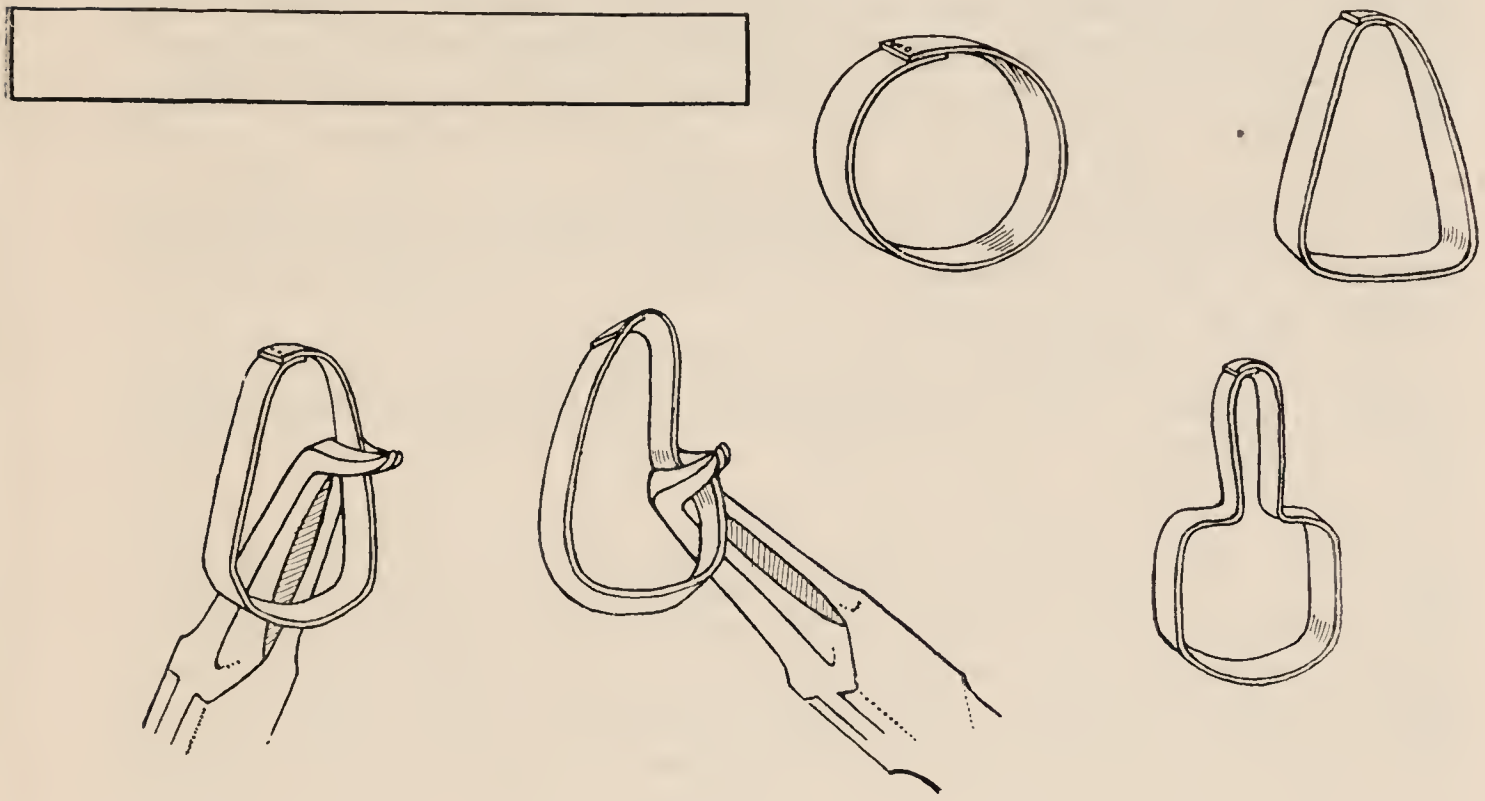


Fig. 7.—Diagrammatic drawing of upper left first permanent molar with outline of plain band, (*a*) viewed from the medial aspect, (*b*) viewed from the buccal or lingual aspect.

neck of the tooth and is more marked. Above this point the surface is inclined in the opposite direction. Viewed from this aspect, a collar, to get a grip of the tooth, would require to go slightly above the end of the main inclinations (Fig. 7 (*a*)).

Fig. 7.—The view of the medial and distal sides from either the buccal or lingual aspect is quite different. The coronal quarter of the medial side is inclined upwards and outwards. Above this



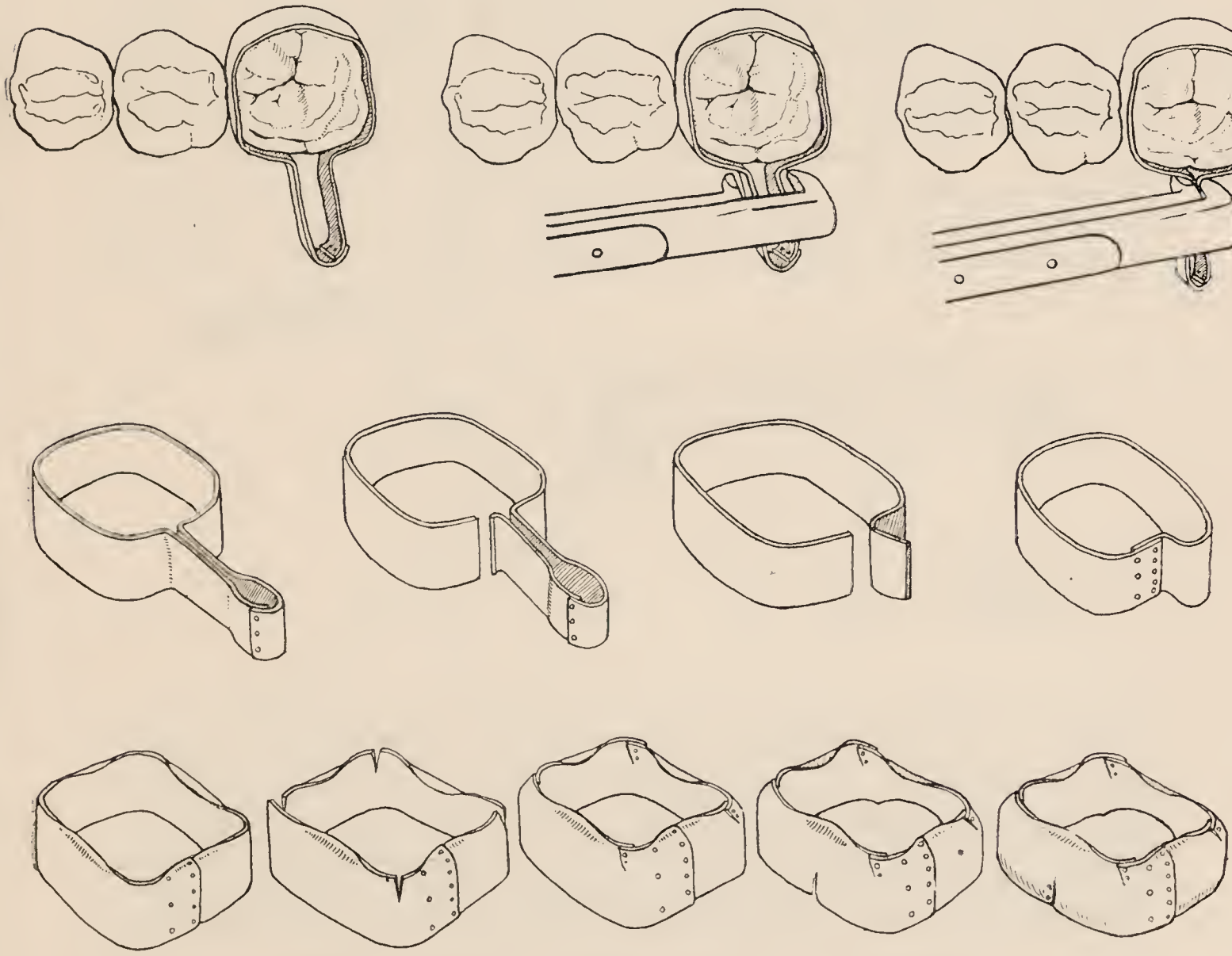


FIG. 8.—Stages of upper molar band construction.

point it is flat for a short distance and is then inclined in the opposite direction. On the distal side the coronal half is inclined upwards and outwards at about the same angle as the rootwards inclination of the medial surface, these portions of each surface being nearly parallel to each other. Above the end of the inclination on the distal surface, i.e. above about half-way, the surface is inclined in the opposite direction. So here we have two surfaces each divided into two parts, the gingival inclination of one side being parallel to the coronal inclination of the other side. It is obvious from this that a band can only fit the whole of three inclinations.

Fig. 7 (*b*).—We recognise this difficulty every day. The ring can be easily worked up on the medial side, but if the band is sufficiently tight we have great difficulty in getting anywhere nearly up on the distal side.

There are undoubtedly great variations in the form of the sides of upper molars. Thus one may meet with medial surfaces nearly vertical below the contact point, or distal surfaces less bulged than the average.

Fig. 8.—The ends of a piece of band material, polished on one side, about 6 cm. long by 5 or 6 mm. wide, are joined together. The electrodes (*a* and *b*, Fig. 24) used are two plain fine points about 2 mm. diameter at the points, the current used being (Low) and the switch being in operation for the shortest possible time. The loop is now shaped so that the part further from the joint is made approximately to fit the buccal surface of the tooth. The band is held in a Pullen's band-forming pliers about 8-9 mm. from the disto-buccal angle and is bent at right angles in order to form the disto-lingual angle, and at the same time it is bent at right angles in the opposite direction nearer the welded joint. A double bend in opposite directions is thus made at the one operation. The band is now turned over, and a similar procedure is done 8-9 mm. from the medio-buccal angle. The band is now in the form of a ring with two tails, like a pull-to joint. This ring is placed on the tooth in the required position and is squeezed

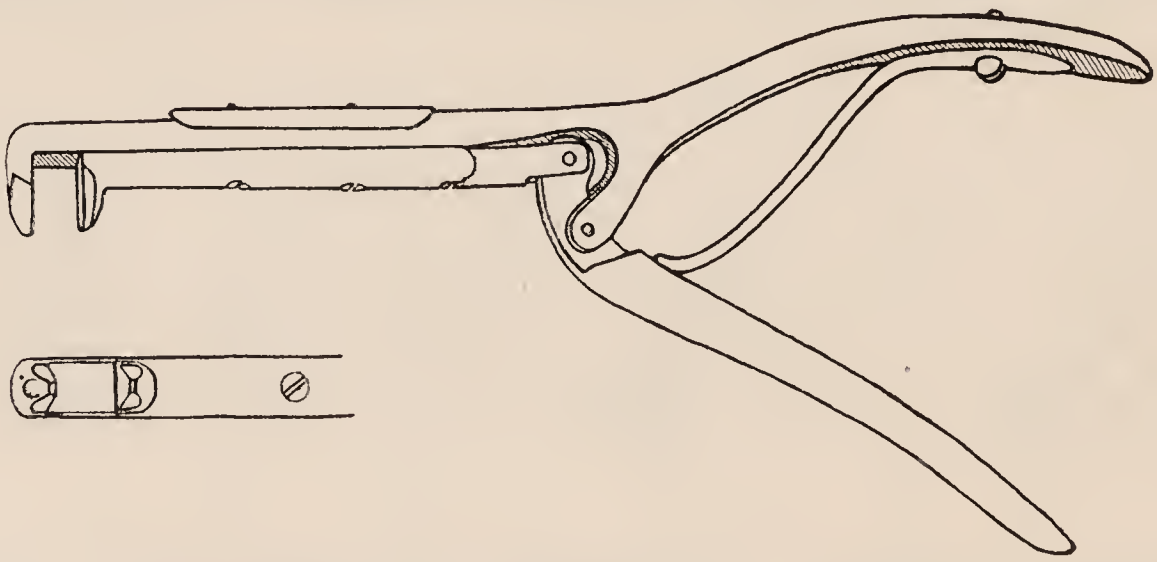


FIG. 9.—Band-forming pliers, blades working at right angles to shaft.

with a special band-forming pliers (*Fig.* 9), the blades of which work at right angles to the shaft. The ring is removed (*Fig.* 8). One tail is cut slightly ringwards of the crease made by the pliers and the other tail is cut off about 3 mm. tailwards from the crease. The side cut close to the crease is lapped over the 3 mm. projection

to the crease and welded. This cutting of the ring a little short of the crease makes the fit a little tighter. The squeezing of the ring on to the tooth does get, to a large extent, the shape of the tooth. The band is now placed on the tooth, and with the help of a wooden tongue depressor and Pullen's band adaptor and round orange-wood sticks, it is driven up to the required position. If it has been made too tight it can be enlarged with a Mershon's contouring pliers at the point where it is bearing, usually the distal surface, though at times the medio-lingual surface. When pushed up to the proper position, the centre of each of the four coronal margins is burnished in with a burnisher. The ring is removed and the four coronal corners cut with scissors to a depth of about 1 mm. With a S.S. White pliers No. 118, the cut corners are overlapped and then welded. A vertical cut about 1.5 mm. long is made with scissors at the centre of the medio-cervical margin. The disto-cervical margin is festooned. With a S.S. White pliers No. 118, the cervical edge is bent inwards, starting at the centre of the buccal and lingual sides and working to the cut on the medial side and along the festooned distal side. The overlapped cut on the medial side is welded. The projecting corners where the band has been cut, overlapped and welded should be flattened with a contouring pliers. The band is again put on the tooth and gradually worked up to the required position. The coronal edge is burnished all round. If the distal coronal edge should overlap on to the occlusal surface, this overlap should be filed away with an oval file.

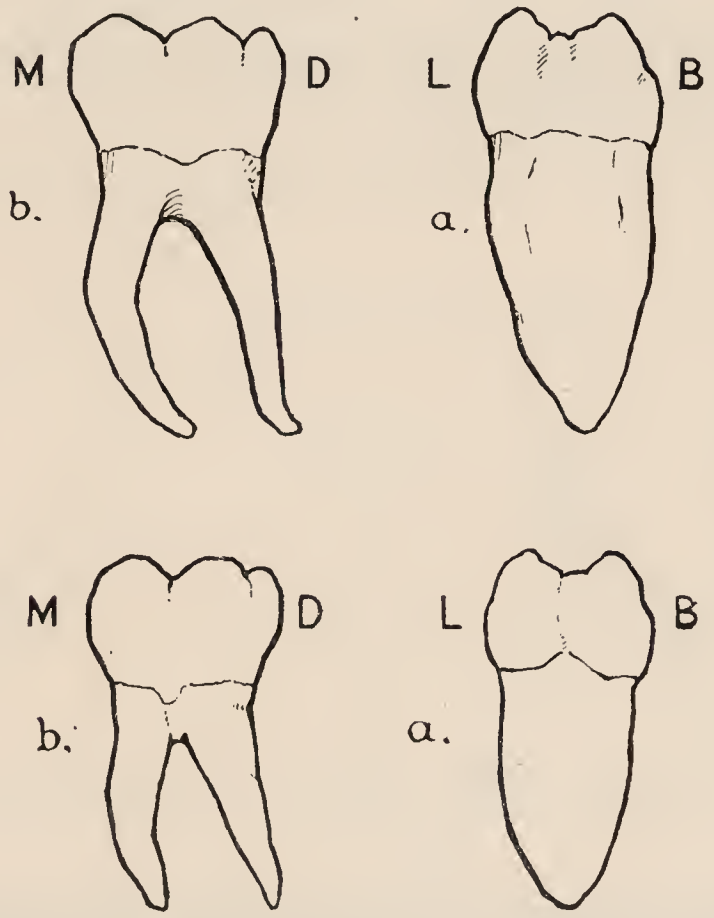


FIG. 10.—Drawing of two lower left first permanent molars, (*a*) viewed from medial aspect, (*b*) viewed from buccal aspect.

Fig. 10 (*a*).—*The lower molar* presents quite a different shape to the upper molar. As viewed from the medial aspect, the buccal surface is sharply inclined downwards and outwards relative to the long axis from the coronal margin to about 2 mm. above the enamel cementum junction. Below this point it takes a reverse

inclination. On the lingual side the upper part of the surface is similarly inclined to about 4 mm. above the enamel cementum junction. Below this the surface is flat for about 1 to 2 mm. and then it is inclined downwards and inwards. This latter inclination is nearly parallel to the main inclination of the buccal surfac (*Fig.* 10 (*b*)). Viewed from the buccal side, the medial surface is parallel to or slightly inclined downwards and outwards to the long axis of the tooth, to about midway between the coronal and cervical margins. Below this it is flat for a short area and then inclined downwards and inwards. The distal surface is more sharply inclined downwards and outwards to about a third of its height below the coronal margin and is nearly parallel to the rootwards inclination of the medial surface. It is then inclined downwards and inwards. Diagramatically the tooth presents the

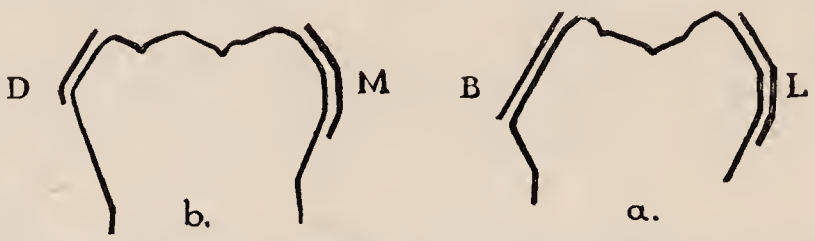


FIG. 11.—Diagrammatic drawing of lower right first permanent molar, with outline of plain band, (*a*) viewed from medial aspect, (*b*) viewed from buccal aspect.

following shape (*Fig.* 11). The main buccal surface is parallel to the gingival third of the lingual surface. The coronal third of the distal surface is parallel to the gingival third of the medial surface. Here again the buccal, lingual, medial and the coronal half of the distal surface can be banded, keeping the cervical edge of the band close to the tooth.

It must also be pointed out that the long axis of the lower molar, in the mouth, is inclined lingually (*Fig.* 12).

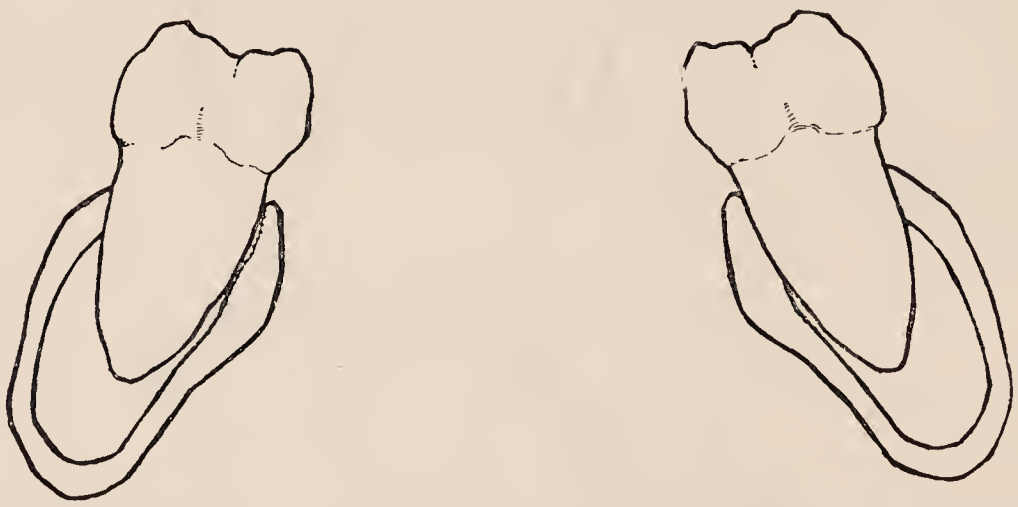


FIG. 12.—Drawing of section through the mandible and the first permanent molars. About 8 years of age. Showing lingual inclination of molars.

Fig. 13.—The procedure in making the lower bands or rings is slightly different. The ring is squeezed on the buccal side. After it has been fitted into place after welding, it is removed and the coronal edge treated in the same way as the upper molar bands. The band is festooned on the distal gingival side. A vertical cut, about 2 mm. long, is made from the cervical margin about the centre of the lingual surface, the sides of the cut well overlapped and welded ; a similar cut, not so long, is made from the cervical

margin about the centre of the lingual surface, the sides of the cut well overlapped and welded; a similar cut, not so long, is made from the cervical margin about the centre of the medial surface, the sides of the cut overlapped and welded.

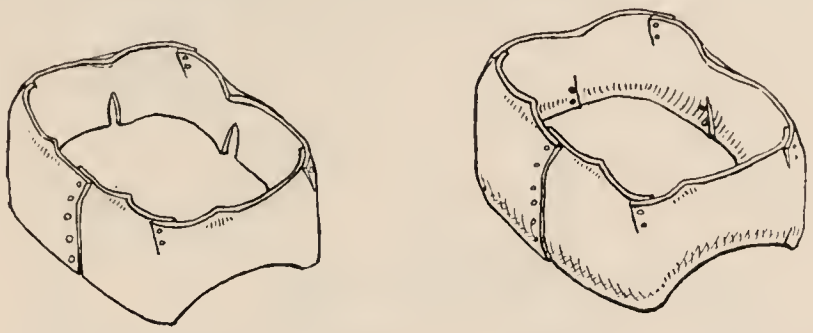


FIG. 13.—Final stages of lower molar band construction.

It must be remembered that the original squeezing of the band material around the tooth does not make the band conform fully to the shape of the lingual and medial surfaces. It will be found that there is a gap between the tooth and the band below and above the flat middle area (*Fig.* 14). The cutting and overlapping of the coronal corners and the cutting and overlapping on the cervical lingual and medial surfaces make it possible for the band to fit closely to the whole lingual and medial surfaces.

With regard to *deciduous molars*, material 5 mm. wide and .13 mm. thick is suitable. Deciduous molars, more especially the lower second deciduous molar, generally have a more marked inclination of their buccal and lingual surfaces. This is partly due to the belt of enamel near the cervical margin. This belt of enamel near the cervical margin makes it almost impossible to make the band project beyond this belt and yet fit the tooth to any reasonable degree. I have found that it is not wise to extend the band beyond the enamel belt.

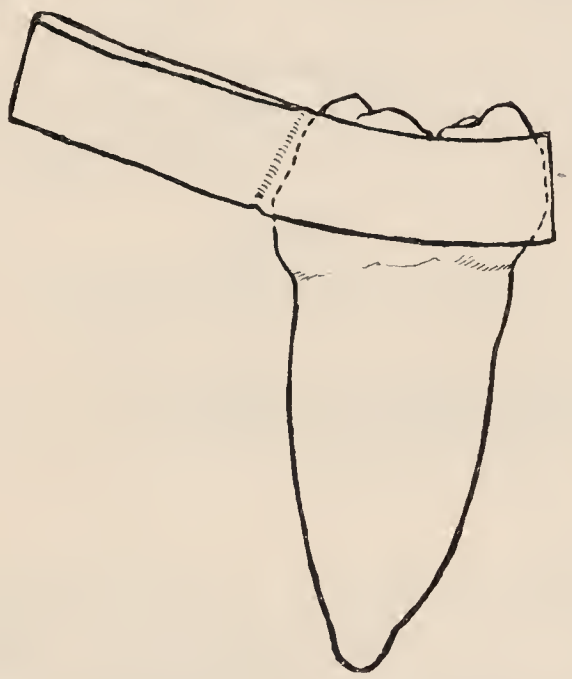


FIG. 14.—Diagrammatic drawing of lower right first permanent molar from medial aspect, with outline of band material squeezed together on buccal surface. Showing gaps between the band material and the tooth below and above the flat area of the lingual surface.

The rings having been made, an impression is taken with the rings on the teeth. The rings are removed and placed in the impression. A pledget of cotton-wool is placed in each ring on the side to which the tube is to be attached and the impression cast.

This pledget of cotton-wool facilitates the removal of the plaster from the inside of the ring on the side to which the tube is to be welded.

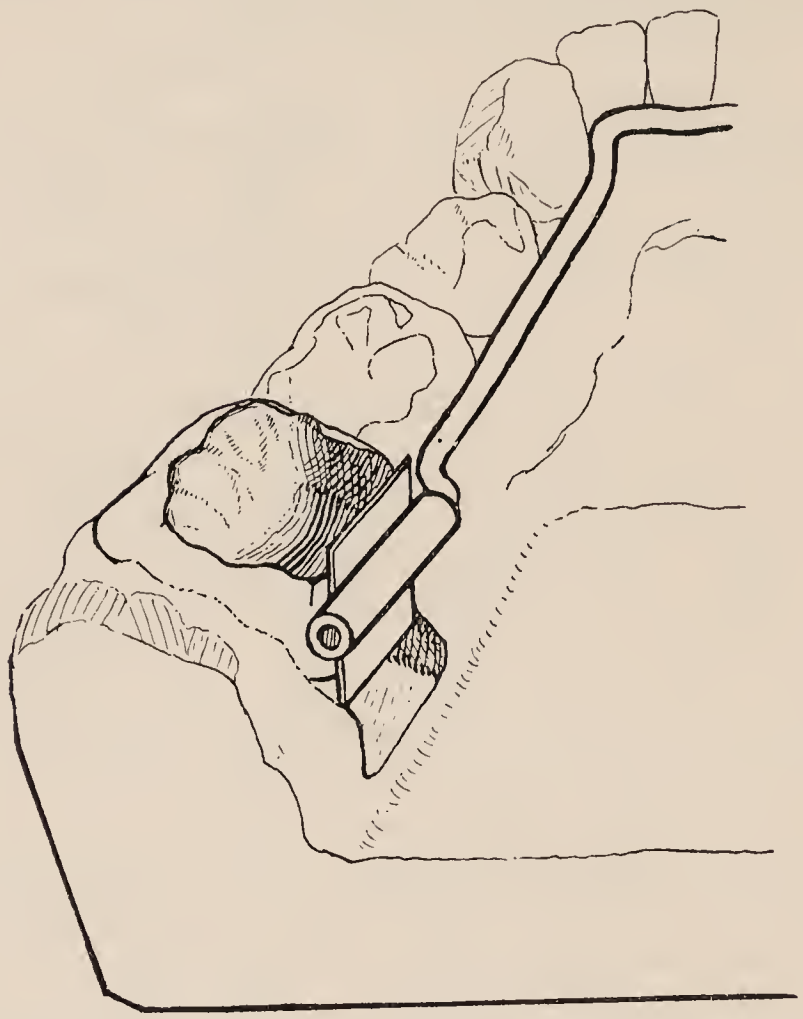


FIG. 15.—Drawing of model with half the plaster removed from inside of molar plain band on side to which the tube is to be welded. Lingual arch with horizontal tube and flanged attachment ready to be welded.

Fig. 15.—The plaster has to be cut away sufficiently to accommodate the electrode.

2. ARCHES OR BOWS.

The required type of arch is now bent to the model. Great care must be taken as no final fitting with heat can be employed.

3. TUBES.

Three types of attachment of the arch to the rings will be described.

(*a*) By horizontal tubes.
(*b*) By rectangular vertical tubes.
(*c*) By round vertical tubes.

(*a*) *Horizontal Tubes.*

Tubing to fit either 1.0 mm. or .8 mm. wire can be obtained in long lengths. This has to be cut up into suitable lengths with a three-cornered file.

It is evident, from the shape of the lingual surface, that the tube will only touch the ring at one point and that this would not give sufficient strength when welded (*Fig.* 16). Consequently the tube is ground on a stone on the lathe on one side fairly deeply, the ground surface being about 5-6 mm. long and 1.5 mm. wide. A piece of ribbon material polished on one side, .2 mm. thick and 5-6 mm. wide, is laid on the ground portion of the tube and held between the electrodes of the welder. The electrode (*c*, Fig. 24)

in contact with the tube is grooved at its point transversely 4 mm. wide in line with groove and 2 mm. long across groove. The other electrode (*a*, Fig. 24) is a fine point. This electrode is in contact with the unpolished side of the ribbon material. (High) speed is used in welding the ribbon to the tube along the length of the ground surface of the tube.

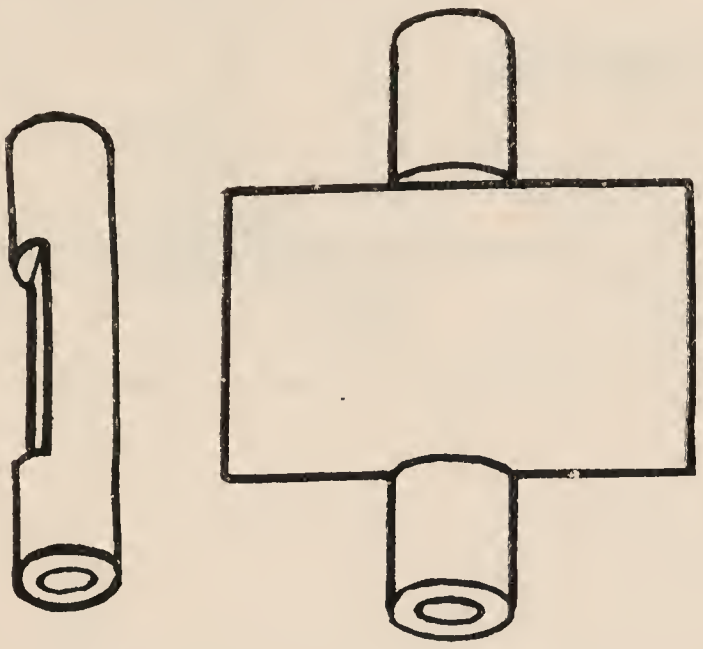


FIG. 16.—Drawing of tube ground on one side ; tube and ribbon material.

(*b*) *Rectangular Vertical Tubes.*

The tubes, with their flanged attachments, are put on the arch and are placed on the model (Fig. 15). The tube is welded to the ring on the model at the point of contact right through tube, arch, ribbon material and ring. The electrodes *a* and *b*, Fig. 24, are used. Then the ribbon material is bent with pliers (118, S.S. White) to fit closely to the ring, coronal to the tube and welded to the ring at a couple of places. (Medium) speed. The rings are now removed from the model, the ribbon material closely bent to the ring and welded. (Medium) speed. The surplus of ribbon material is cut off and ground smoothly with a stone.

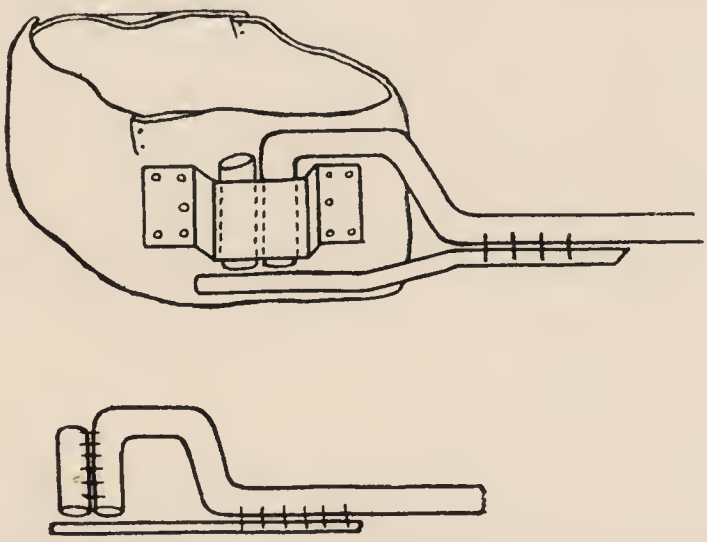


FIG. 17.—Drawing of end of arch bent at right angles, with a piece of similar wire welded to it, forming the rectangular pin which engages the rectangular vertical tube. Soft wire latch welded to arch to engage bottom of vertical tube.

Fig. 17.—The ends of the arch are bent at right angles. To this right-angled pin is welded a piece of wire of the same thickness, so that the single pin is now double, both lying in close contact with the ring on the molar, electrodes *d* and *d*, Fig. 24. *Fig.* 18.—A

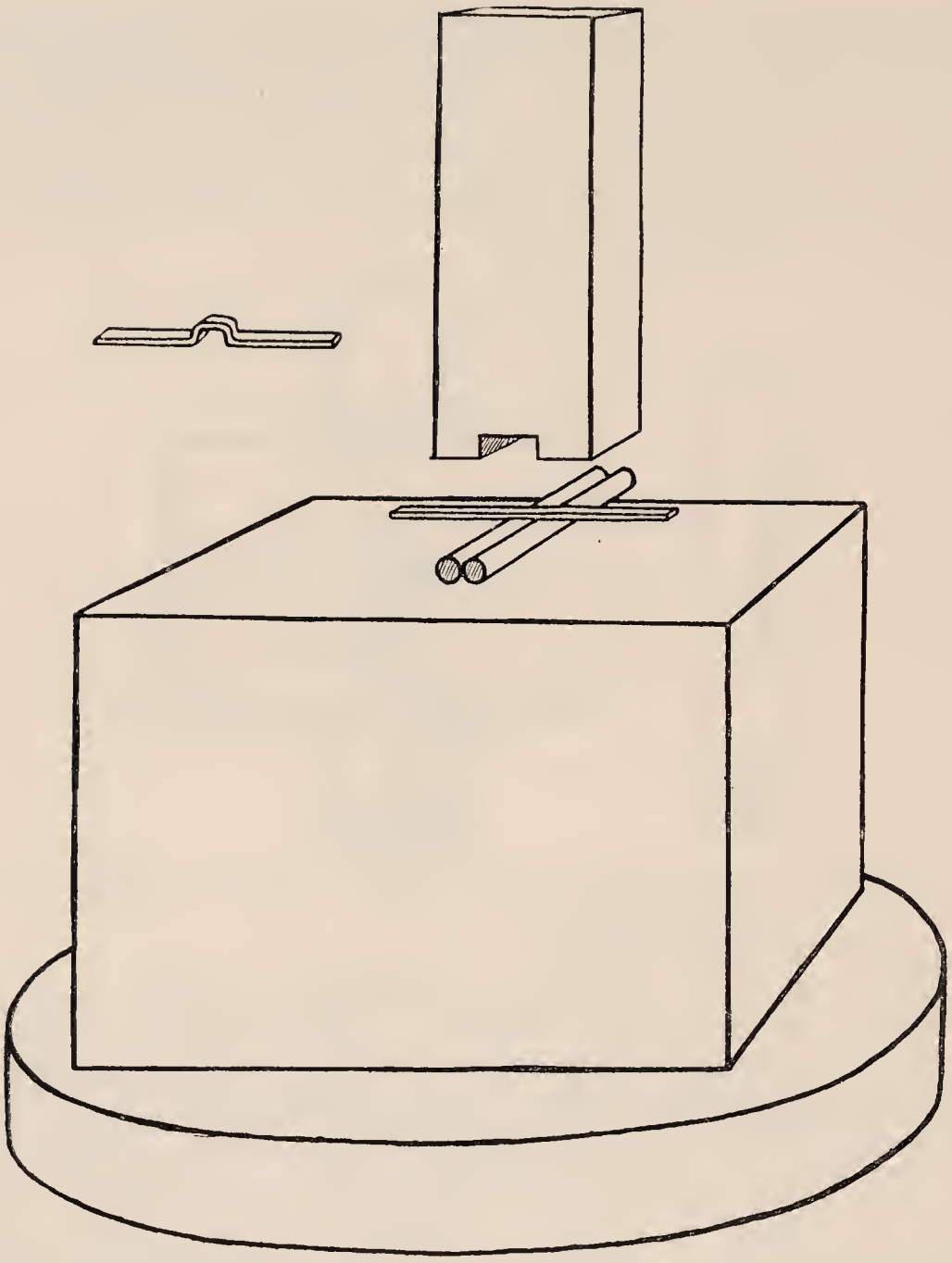


FIG. 18.—Construction of strap vertical tubes. Punch, ribbon material, double wire and anvil.

piece of .2 mm. ribbon, the width of the height of the pin and about 14 mm. long, is stamped with a punch over a double wire similar to the double pin. This stamped piece of metal constitutes the outer and side walls of the vertical rectangular tube, the ring constituting the inner wall (Fig. 17). The ends of the stamping where they project beyond the side walls of the tube are welded to the ring on the model, two fine-pointed electrodes (*a* and *b*, Fig. 24) being used. (Medium) speed.

(*c*) *Round Vertical Tubes.*

Where it is desired to rotate the molars, round strap vertical tubes are used. These are made in the same way as the vertical rectangular tubes, and the same electrodes and current are employed.

Latch for Vertical Tubes.

The ends of the pins are cut off flush with the cervical ends of the tubes. A piece of soft steel, .7 mm. thick, is welded to the arch as a latch (Fig. 17). The electrodes *d* and *d*, Fig. 24 used are very narrow and are grooved transversely to hold the wires. (High) speed.

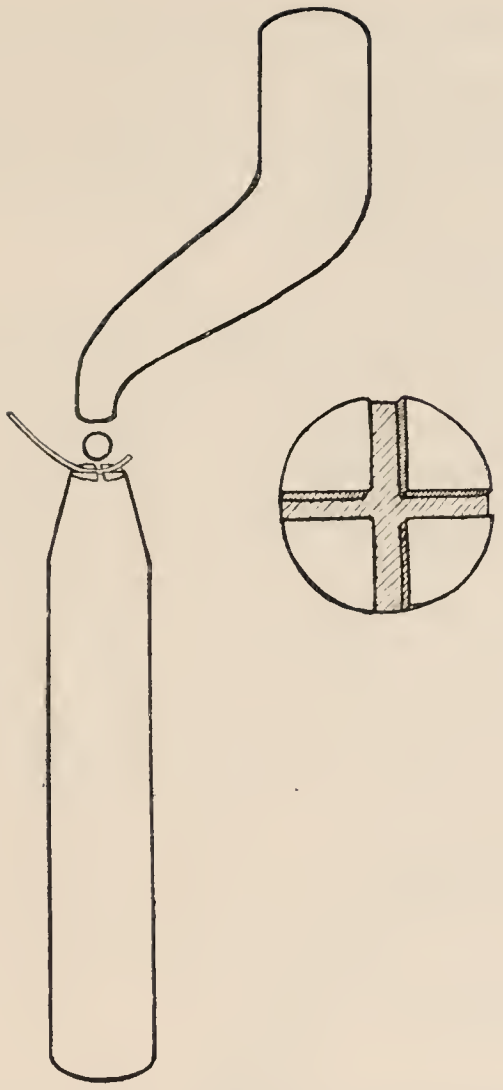


FIG. 19.—Drawing of construction of auxiliary spring. Electrodes (*a* and *e*).

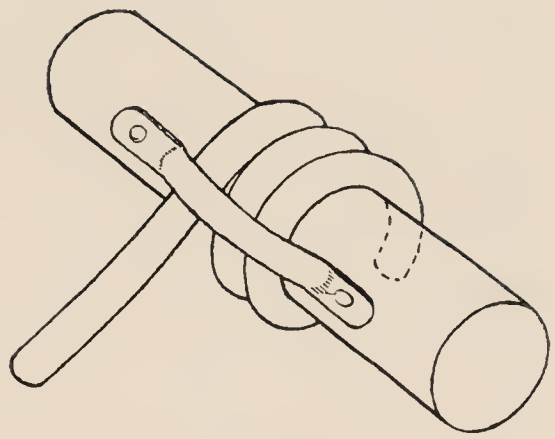


FIG. 20.—Drawing of construction of auxiliary spring. Coils around arch and strapping.

4. AUXILIARY SPRINGS FOR LINGUAL ARCHES.

The attachment of auxiliary springs to the arch presented many difficulties, and the method found most satisfactory is as follows.

Fig. 19.—The end of the spring wire is sharply curved, the curve being about 1 mm. This curved portion is hooked under the arch at the place where it is desired to weld it, thus being at right angles to the line of the arch. The curved portion lies between the arch and the gum, the main coil of wire extending forwards. The spring wire rests in a large grooved electrode (*e*, Fig. 24) 2.5 × 3.5 mm. at the point, so that it cannot be flattened out during welding, and a pointed electrode (*a*, Fig. 24) is used on the arch, 2.0 mm. diam. at the point. (Medium) speed is used. The spring wire is then held firmly and bent a further quarter turn around the arch and the spring welded again with (Low) speed.

Fig. 20.—Now the spring is given three complete turns around the arch, the coils being as close together as possible. This makes a very efficient spring as long as pressure is exerted to tighten the coils, but most inefficient if pressure should be exerted the other way. In the latter case a tearing force is exerted on the weld and it very easily breaks. To prevent pressure being exerted in this direction, a strap is welded at each end to the arch across the three turns. This acts as a stop, preventing the spring being unravelled. The auxiliary spring is now completed into whatever form is required.

The efficiency of the auxiliary spring depends upon at least three factors.

(*a*) Elasticity of the material, so that there can be considerable range of deflection before reaching the bending point.

(*b*) Stability. It is essential that the spring is reasonably safe and is not easily displaced or broken.

(*c*) Action in direction desired only.

Stainless steel hard drawn .4 mm. diam. offers an extremely elastic material, and this elasticity can be improved by the form of the spring. It is possible to have a pressure not exceeding a maximum of 2 oz. on each tooth with a deflection of 4 mm. Such springs can be left safely for three months without alteration. They apparently move the teeth with far less tilting than stronger springs. This may be due partly to the direct action of the spring to its stability and to the gentleness of the force. The forces of occlusion may assist considerably in keeping the teeth upright when the pressure of the spring is very weak. It is important that *the coils when the main spring is deflected should tighten rather than open.*

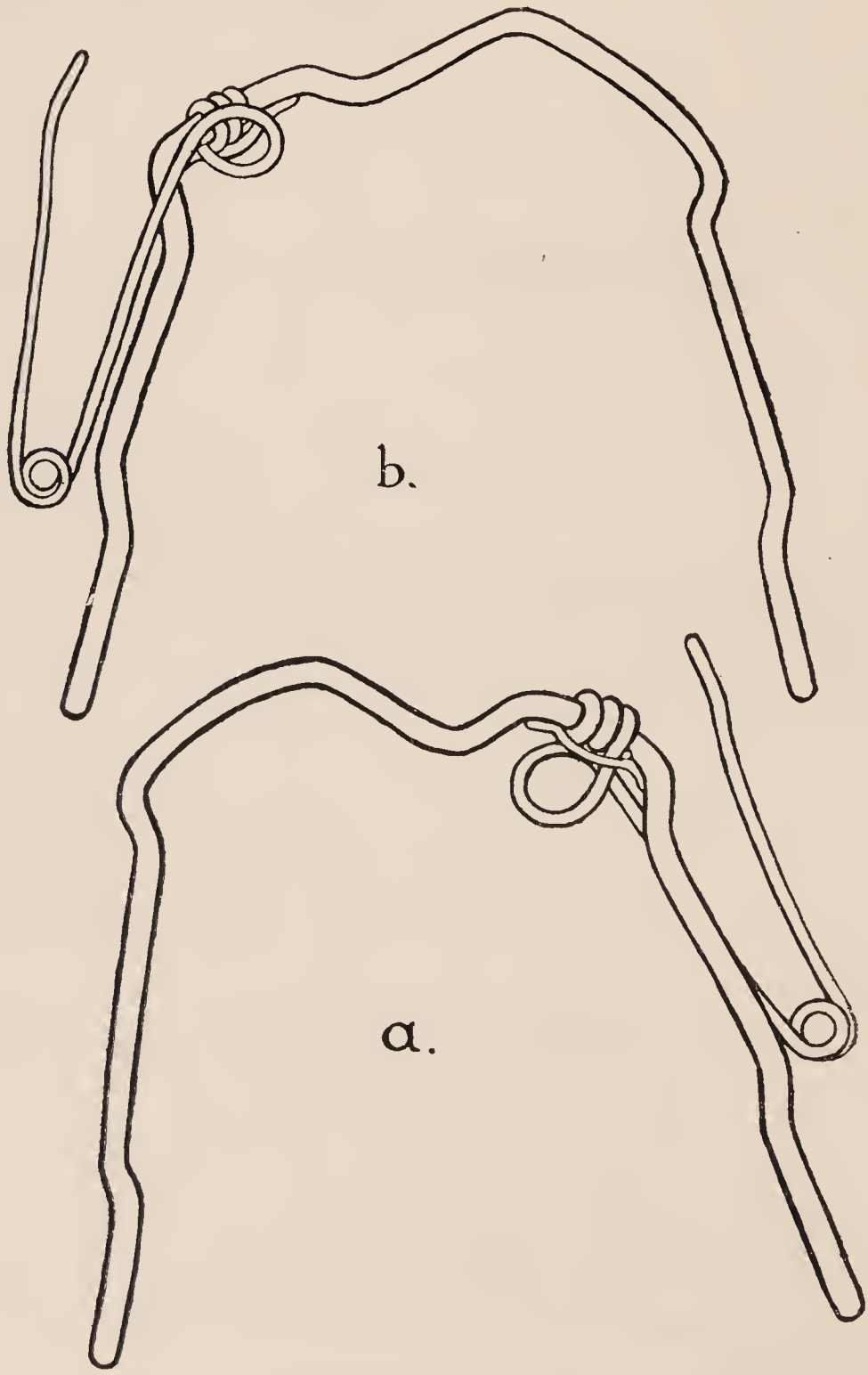


FIG. 21.—Drawing of double auxiliary spring for buccal movement, (*a*) viewed from side away from gingiva, (*b*) viewed from side in contact with gingiva.

I shall describe the construction of four types of auxiliary springs.

(1) A spring for buccal movement.
(2) A spring for labial movement.
(3) A spring for molar rotation.
(4) Retraction springs.

(1) *A Spring for Buccal Movement.*

Fig. 21.—The spring is welded at right angles to the arch, and lying between the arch and the gum about 3 mm. medial to the angle that the legs of the arch make with the front. Probably opposite the lateral incisor. After the three complete turns around the arch and the strapping, it is given a single coil medially and brought back following the line of the arch as far back as expansion is required, the spring being between the arch and the gingiva. Then, with a very fine tapered pliers, one nose round, the other flat, a small double coil is made, the coil being buccal to the first arm of the spring. The second arm is brought as far forward as expansion required. It is possible with such a spring to form it so that the type of expansion required is obtained. Its action is much more direct than a single-armed spring. The pressure is less and more evenly distributed over the whole bearing surface. With a single-armed spring the pressure increases and the deflection decreases rapidly from the free end to the point of attachment.

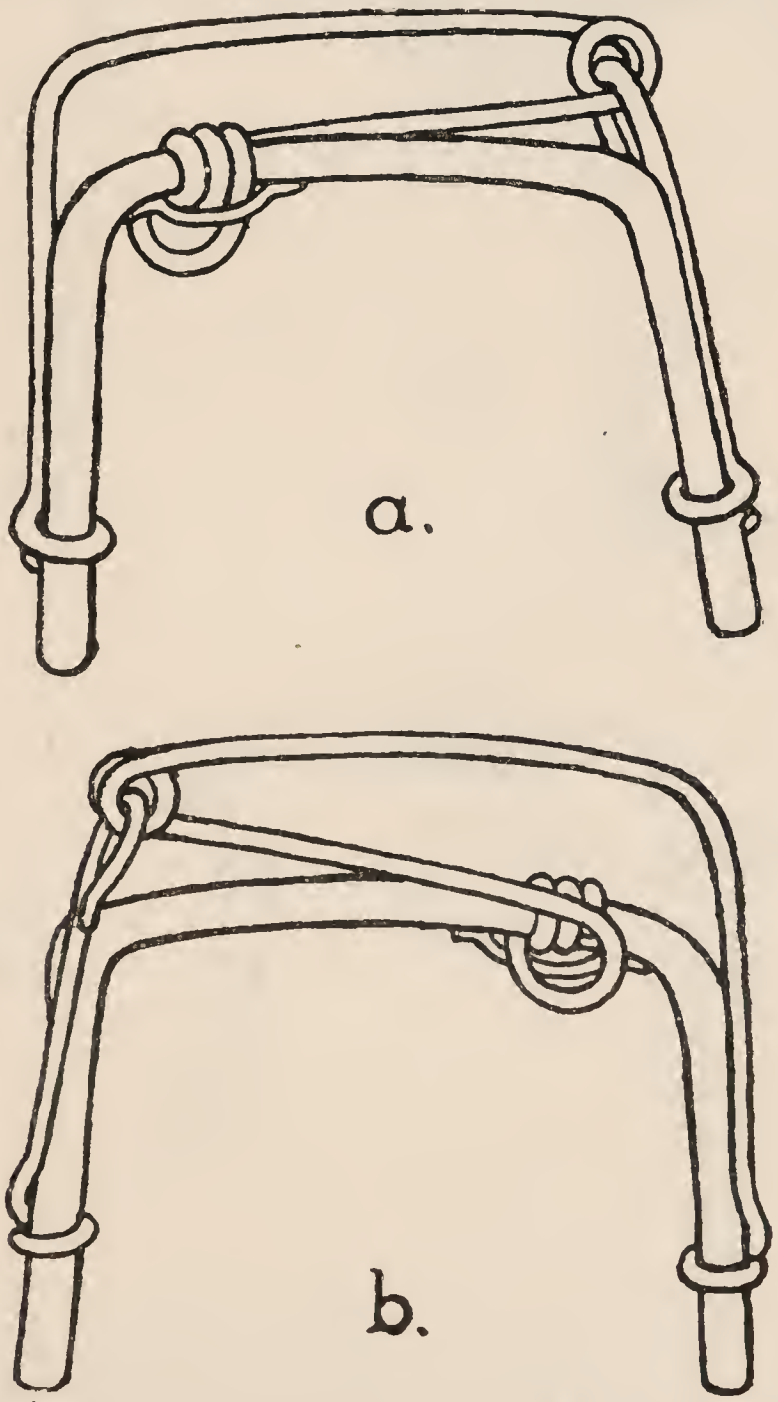


FIG. 22.—Drawing of double auxiliary spring with captive ends for labial movement, (*a*) viewed from side away from gingiva, (*b*) viewed from side in contact with gingiva.

(2) *A Spring for Labial Movement.*

Fig. 22.—This spring is an improved form of the lateral spring. A spring similar to the lateral spring has several disadvantages in the front of the mouth. It frequently rides on the inclined surfaces of the incisors and is then not acting in the direction required. The free end and the angle of the recurve are liable to get caught up either by food or the tongue. The spring is constructed the same as the lateral spring, but the free end is bent at nearly a right angle and passes underneath the corner of the arch and is twisted around the leg of the arch. The angle of the recurve is held in position by a piece of .4 mm. wire looped around the curl and welded, the free end being brought underneath the corner of the arch, and twisted around the leg of the arch. Such a spring has a concertina action, the guides running

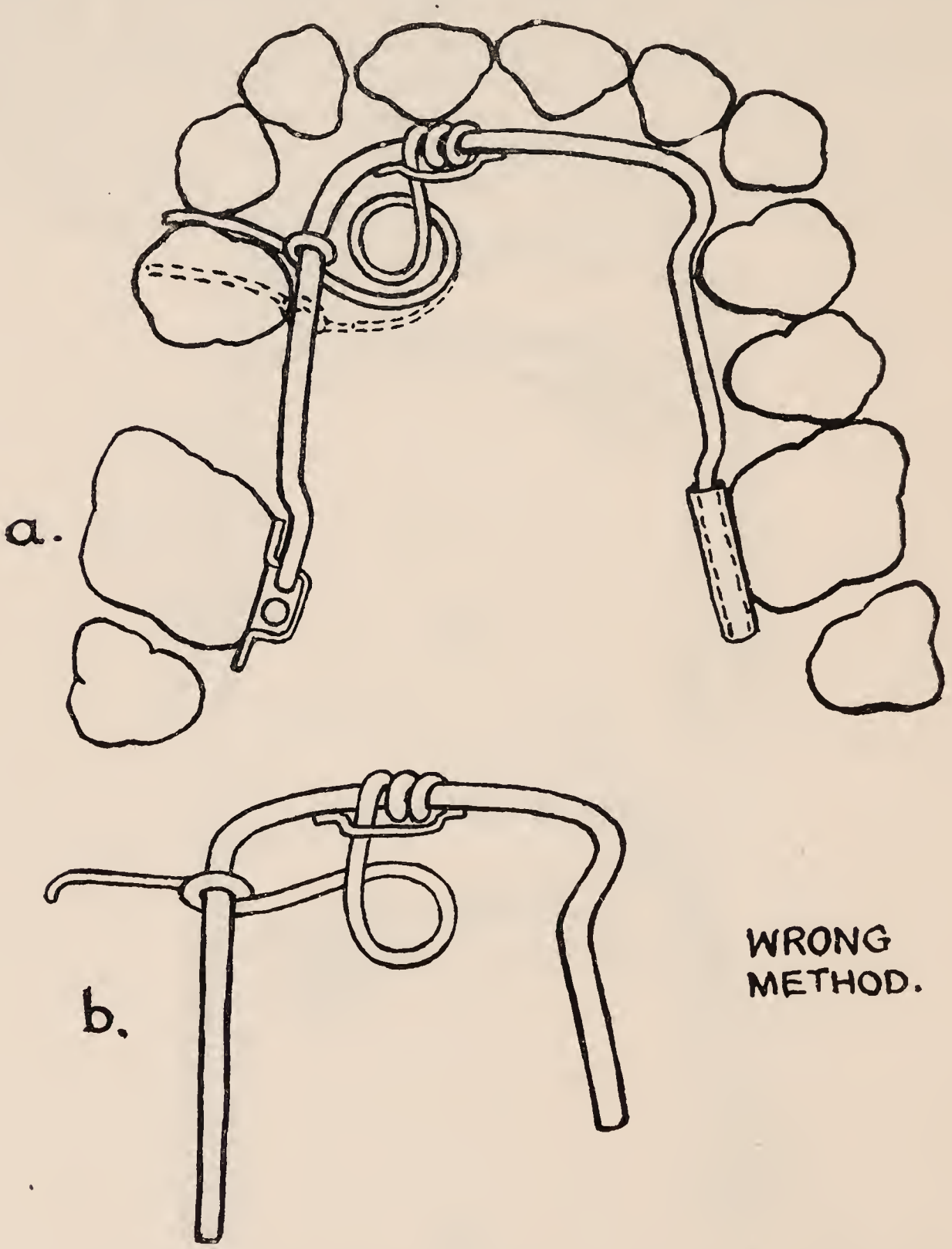


FIG. 23.—Drawing of retraction spring, (*a*) deflection of spring tightens coils, right method, (*b*) deflection of spring opens coils, wrong method.

on the legs of the arch. These guides are much more efficient than guiding spurs in keeping the spring in place and in keeping its action in the right direction.

The electrodes for welding the loop around the angle of the recurve are two large grooved electrodes (*e* and *e*, Fig. 24) and (Low) speed is used.

(3) *Molar Rotation Spring.*

This spring has been described by me, before this Society, in 1927. The .4 mm. wire is welded to the back of the molar ring, using a grooved electrode (*e*, Fig. 24) for the wire and a pointed electrode (*a*, Fig. 24) for the inside of the ring. (Low) speed is quite sufficient.

(4) *Retraction Springs.*

Fig. 23.—This spring is very useful for the retraction of a canine or for moving any tooth along the line of the arch in either direction. Great care has to be taken that when the spring is deflected it tightens the coil.

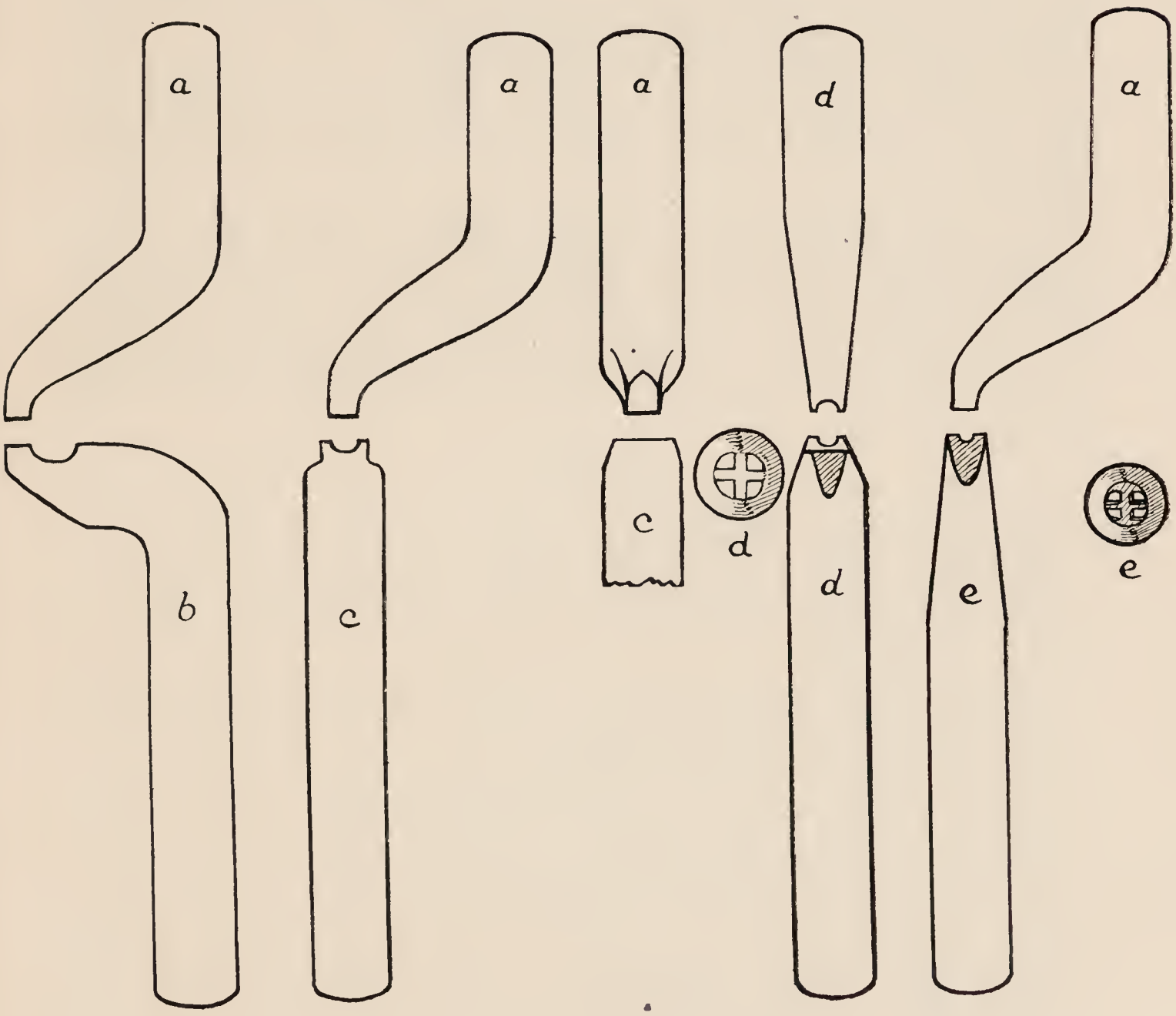


FIG. 24.—Drawing of electrodes *a*, *b*, *c*, *d*, *e*; *a* and *b* for band material; *a* and *c* for band material to tubes; *d* and *d* for thick wires; *a* and *e* for spring wire to arch wire.

5. Labial Extensions from Lingual Arch.

(1) Retraction and lingual movement of canine.
(2) Lingual movement of incisors.
(3) Rotation of incisors.

These labial extensions have to be made of thicker wire than the auxiliary springs; .6 or .7 mm. are the most suitable sizes. Here again the extension is welded underneath the arch, i.e. gumwards and coiled once round the arch and then brought out between two teeth. Grooved electrodes (*d* and *d*, Fig. 24) are used in order not to flatten out the wires too much and (High) speed current.

6. Hooks for Intermaxillary Traction.

(1) Hooks on buccal arch.
(2) Hooks on molar bands.

Hooks on the buccal arch are best made of wire .8 mm. thick, the arch and the wire for hook being filed a little to give better contact, using narrow transversely grooved electrodes and (High) speed (*d* and *d*, Fig. 24). Hooks on the molar bands are welded obliquely from the medio-buccal occlusal angle to near the cervical margin and then bent outwards, and inwards.

The appliances described are a fair example of those used by orthodontists who do not use ready manufactured appliances, and show the possibilities of this material and the method of welding.

I am very grateful to Dr. De Coster of Brussels for having initiated me into the use of electric welding, and to Mr. H. T. McKeag and my brother, Mr. Ralph Friel, for the great help they have given me in the writing of this paper, and to Miss Wilson for all the drawings. I would also like to thank Mrs. Lindsay for the great amount of trouble she took in obtaining information for me.

APPENDIX.

1. Horizontal Round Tubing.

Inside diam. 1 mm.	Outside diam. 2 mm.	= .039″ × .078″	Thick walls.
Inside diam. .8 mm.	Outside diam. 1.8 mm.	= .031″ × .070″	
Inside diam. 1 mm.	Outside diam. 1.5 mm.	= .039″ × .059″	Thin walls.
Inside diam. .8 mm.	Outside diam. 1.3 mm.	= .031″ × .051″	

2. Band Materials.

Polished one side. In soft state.

.2 mm. × 11 mm. Used for making vertical tubes, strapping for horizontal tubes, and for making horizontal tubes.

.15 mm. × 5 mm. = .0058″ × .196″	*Permanent molars.*
.15 mm. × 6 mm. = .0058″ × .236″	
.13 mm. × 5 mm. = .0050″ × .196″	*Deciduous molars.*
.08 mm. × 5 mm. = .0031″ × .196″	*Incisors.*
.08 mm. × 6 mm. = .0031″ × .236″	

3. Wire. Polished.

1 mm. diam. = .039″	Fairly hard.
.8 mm. diam. = .031″	Medium hard.
.7 mm. diam. = .027″	
.6 mm. diam. = .023″	Hard.
.4 mm. diam. = .015″	
.7 mm. diam. = .027″	Soft, for latch wire.

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Discussion.

Mr. W. A. Bulleid desired to congratulate Dr. Friel on the extraordinary ingenuity which he had shown, as he had done on previous occasions, in these mechanical contrivances. His ingenuity was quite amazing. There was one omission which he noted. Dr. Friel had not told the Society what rustless steels he was using, for their name was legion. Two quite distinct groups were the chrome steel and the chrome nickel steel. He presumed he used the chrome nickel steel. The speaker had been using rustless steel exclusively for the last twelve months in orthodontic work and also in plate work. He was using Firth Staybrite F.S.T., a hard-drawn steel which did not lose its temper very much by heating. This could be obtained in any section and diameter required. He had also been using it for making bands. There again Dr. Friel had not told them what steel he used for bands, and it would be of interest to hear. He felt inclined to traverse entirely Dr. Friel's statement with regard to soldering these steels, and he did not care what solder it was that was used. The solder that was recommended was a turbine brand of silver solder. But if it was preferred to use the high-grade gold solders such as were sold by S. S. White, and which were formerly used with the gold platinum alloys, these were quite satisfactory. For his part, he preferred soldering to welding, especially when it came to attaching the light wires to the heavy arches. He found that the weld did in fact draw the temper of the light wires very materially. He had been immensely interested in the springs which the author had shown; they were very ingenious, but he desired to ask whether he found any tendency for the welds to snap. As Dr. Friel had stated, it was an extremely small area of attachment, and his own experience, which was not as great as Dr. Friel's, had been that these springs broke off at the point of weld. With the solder this difficulty was obviated to a great extent. On the question of welding his attachment to his bands, the method which Dr. Friel had shown appeared to him rather elaborate, and he wondered if he did not find a substantial distortion of the bands as a result of welding. He had found that when welding a steel band to a plate, the weld had slightly distorted it.

Mr. Visick said that the Society had expected something practical and artistic from Dr. Friel, and had not been disappointed. The only trouble was that he made it all appear so simple that he suspected there was a snag somewhere. He wondered whether the "snag" was not technical skill in using his welding apparatus. The speaker himself had never tried to use one of these; they all looked very clumsy when dealing with tiny objects. He wished to ask Dr. Friel whether he had ever found that after welding one spring wire satisfactorily, on welding another he made a false shot and spoiled the

arch and the spring wire. That would give some idea as to whether it was easy to do these weldings. He was afraid that he had had so little experience of stainless steel that he could not say anything useful on the subject, but during the last few months or year he had been experimenting with stainless steel. The soft solder joint had been tried, but in their hands it had not been satisfactory. The soft solder had corroded and the spring wires had got loose, but he had been using an arch and finger springs made of one piece of wire, and an example of this he showed to the meeting. It was really a latch spring which was extended forward and became a finger spring. The chief point in stainless steel, apart from its cheapness, seemed to him its marvellous elasticity. It seemed twenty times better than any precious metal he had ever tried. Once one had got a spring formed one could hardly destroy it at all. It might be pulled out inches and it would spring back. He showed a specimen which illustrated the marvellous springing properties of this stainless steel. With regard to the bands, he supposed that really one could not contour them in any way except by splitting and bending them together and resoldering.

The PRESIDENT (Mr. H. G. Watkin) said that he had been using stainless steel for about ten months, and, owing to Mr. Bulleid's help, he had been entirely relying on soldering. At the last demonstration meeting he had mentioned that soft soldering had not been a success, but hard soldering had been successful. It was necessary to have a very small flame, about $\frac{3}{8}$ in. long. With regard to cutting tools, Dr. Friel had said that steel wire was very hard on the cutters. For his own part, he got the cutters bright red hot, and dipped them in cold water, whereupon they were "glass" hard. He had been privileged to attend a meeting in Dublin last year at which Dr. Friel gave a demonstration on this subject, and he had used his lingual spring several times since and had found it excellent. He could not see a great advantage of welding over soldering. Soldering was a perfectly good joint, but it required polishing afterwards. The special "turbine" solder kept perfectly nice in the mouth. For a straightforward seam welding was very easy and quick, but if two curved surfaces had to be welded, even Dr. Friel had to file one flat so as to get the surfaces to make a proper joint, whereas one soldering joint made a good job of it and avoided the necessity of filing. He exhibited an example of soldering the tube to the band, and he also showed an example of welding without loss of temper. In conclusion, he congratulated Dr. Friel on the success he had obtained and on the excellence of his drawings.

Mr. CALE MATTHEWS said that in the latter part of last year, he had a very kind invitation from Dr. Friel to attend a meeting in Dublin, but unfortunately he was unable to be present. He had been a few moments late in arriving at the meeting, and he did not know whether in the earlier part of his paper Dr. Friel had entered into the constituent materials he was using, but he had very kindly supplied him with a detailed list which coincided almost exactly with one with which Mr. Bulleid had supplied him a few days earlier. The Society had heard many of Dr. Friel's papers and had seen so much of his work that it was absurd to congratulate him. They knew when he was about to demonstrate to them that they were to see something as near as possible to perfection. The technique he had developed was extraordinarily ingenious, but he would like Dr. Friel to tell them where his actual saving came in. Was it in respect of time, or was it in cost of materials only. It seemed to him that the process took up a considerable amount of time, particularly in the banding. He thought Dr. Friel would agree with him that with the old alloy metals it was possible to make a decent band in anything from fifteen minutes to half an hour, but the method now advocated

by Dr. Friel appeared to him to be a very much longer operation. Was it work which had to be done entirely by himself or could some of it be transferred to a mechanic ?

Dr. FRIEL, in reply, after thanking the members for their reception of his paper, said that Mr. Bulleid would find in the paper itself, portions of which he had not read that evening, a reference to some of the points he had introduced, in particular a list of the gauges of the steel used. With regard to patent rights, Krupps had an English patent for the use of stainless steel in the mouth, and had prevented the sale of English steel for orthodontic work. It is doubtful if the patent would hold in a court of law. It had been contested in Belgium and had not been upheld. The patent expires in May, 1935, and it was desirable for the profession to see that it was not renewed. With regard to soldering *versus* welding, it was very difficult to answer the question as to comparative merits when one had done welding only, and not soldering. But he did feel strongly on the subject of putting a black arch into a child's mouth. His great objection to gold and German silver had been the difficulty of keeping it clean. One would not put a black plate into an adult patient's mouth, so why should one do it in the case of a child ? The child's feelings should be considered just as much as those of the adult. He had been asked whether the springs snapped. They did not, when one coiled the spring around the arch. At first he had dozens of breakages, but for the last five or six months there had been no broken springs at all.

Mr. Visick had suggested that there was some snag about the business. But it was really quite simple. Anyone who was over in Dublin last year would bear him out that it was quite a simple process, and that one became very quick at it. He thought the time occupied, on the whole, was very much the same as with gold alloys. Mr. Cale Matthews had said that he could make a band in from fifteen minutes to half an hour. Well, by this process he could make two bands in twenty minutes, whereas before it took him half an hour to make the two in gold alloy. The welding of the spring was done very rapidly. Mr. Visick had asked whether he botched the arch in putting in the second spring. He certainly did this in the beginning but that had not happened now for many months. One could put the springs as close together as one pleased with welding. If one wished one could put on an anterior spring and a lateral spring at the same time, the two joints almost touching, and as far as he knew he had not been losing temper in his spring wire, at least not since it had been coiled over. The President had asked him a difficult question, but fortunately a kind friend had leaned over to him and given him the answer. It was on the primary circuit that the switch worked. Mr. McKeag, in Belfast, had been using soldering a good deal. He said that in soldering stainless steel one did not get an alloy between the two, but it was only a sticking of the two parts together, and he stated that he had a fair number of horizontal tubes breaking off by reason of a sudden stress. The speaker did not know whether that was the experience of the other workers. Mr. Cale Matthews had asked him whether the mechanic could do a good deal of the work. His own mechanic bent up the arches for him, which was the hardest job, but all the welding he did himself. It was most interesting work. He personally, if gold were now sixpence a pound, would not go back to it, because this was much more interesting and gave him an enormous amount of pleasure. One could use one's ingenuity in making the springs and appliances in a way which one never thought of before.

A hearty vote of thanks to Dr. Friel concluded the proceedings.

HEREDITARY MALOCCLUSION.*

By D. S. Hayton-Williams, L.D.S.

It has often struck me there is very little in orthodontic literature or printed discussion to give an indication as to the best method of treating cases showing a very decided tendency to develop a malocclusion similar to that present in one or both parents. While admitting that hereditary factors are a cause in nearly all malocclusions—may I suggest, diffidently, they are the main cause—I am more concerned at the moment with those similar irregularities in parent and child obvious even to the layman. In practically any case teeth can be so moved as to obtain a perfect occlusion, but it is quite another matter to be certain they will stay there. In these cases of strong similarity between parents and child particular care should be taken to keep tooth movement biological and not merely mechanical. By which I mean not only the gradual movement of the teeth, but a knowledge that the disposition of the musculature of the child's mouth will allow them to stay there.

I find it difficult to explain lucidly my own ideas on the subject, but I feel sure that the number of factors operating in these cases —such as peculiarly high cheek-bones and narrow mandibles giving attachment to muscles—exercise different pressures from those in a more characteristic skull. Also the length and dis-

Case 1. The Mother.

* *Transactions* of British Society for the Study of Orthodontics, 1933.

position of the lips generally might be obviously characteristic of a family.

Case No. 1. *The mother.*—I should imagine you will find little difficulty in memorising the appearance of these models. There is an instanding $\overline{|5}$ and partially erupted $\overline{5|}$, $\overline{4|}$ is missing. The extractions in the upper were not done with the idea of alleviating the crowding.

Case 2. Fig. 1.

Case 2. Fig. 2.

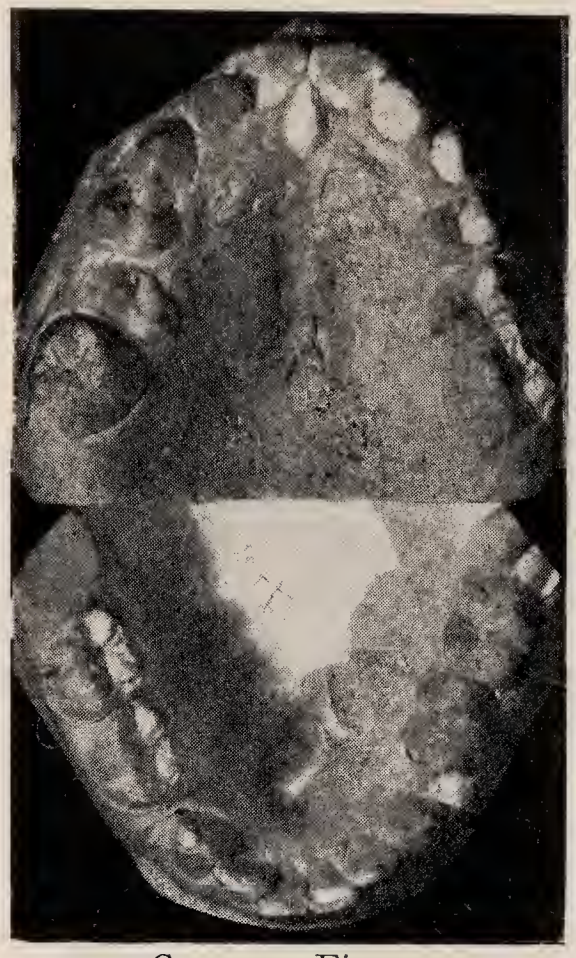
Case No. 2. *The younger child.*—It is at once obvious that immediate treatment was called for, and bearing in mind the mother's mouth and also her statement that such narrowness of the arches was usual in her family, I decided to extract the lower temporary canines. One year later I extracted the upper temporary canines. Of course, only temporary relief, but with periodical observation I can decide when to extract any permanent premolars.

Case No. 3. *The elder child.*—Was brought to me at a later age. Narrowness in the lower incisor and canine region is apparent and also commencement of an overlap in the upper incisors. I hung-fire for six months and these models show the condition then. I extracted the four first premolars simultaneously, as immediate action was called for in the lower and I felt it opportune in the upper, as the permanent canines were erupting. The last models show the case twelve months later—spaces to close, granted, but I think they will.

All these cases have tight lips and cheeks.

In each of these cases I treated, I felt mere mechanical treatment would not give a permanent pleasing result. I am open to

criticism from older and more experienced members, and trust I will have a clearer conception of these cases as a result of any discussion.



Case 3. Fig. 1.

Case 3. Fig. 2.

Case 3. Fig. 3.

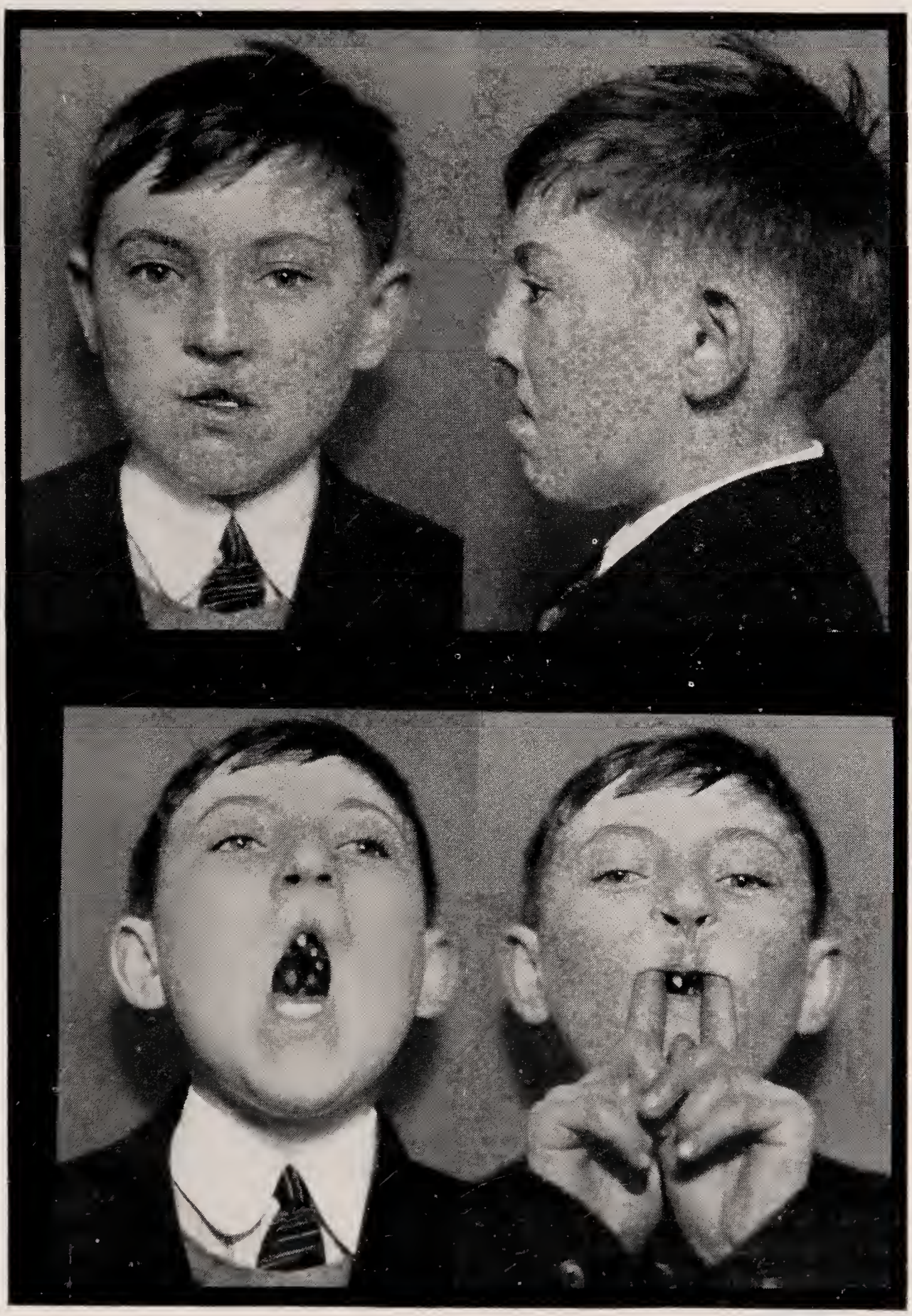
The PRESIDENT said that he thought Mr. Hayton-Williams was quite correct in extracting the teeth in these cases. The case of the mother was a good example of a very narrow mouth. He was quite right in reducing the size of the arches.

CLEFT PALATE AND HARE-LIP: AN ADOLESCENT CASE TREATED ORTHODONTICALLY IN CONJUNCTION WITH A LIP-STRETCHING DEVICE AND SKIN-GRAFTING OF THE LABIAL SULCUS.*

By E. A. Hardy, L.D.S., M.R.C.S., L.R.C.P.

This boy was brought to me at the age of about 13. He had a double hare-lip and cleft palate operated upon and the cleft closed in infancy. The premaxilla was, however, free from the major portion of the jaw. The condition at his first attendance was as follows:

An extremely nervous and apprehensive child (Fig. 1), a severely contracted arch, a microstoma due to a very scarred upper lip which was adherent to the premaxilla (Fig. 2). He was so scared



Figs. 1 and 2.

* *Transactions* of British Society for the Study of Orthodontics.

that he cried at almost anything; even to an impression being taken with "Stent" on two fingers (Fig. 3). The mouth opening was so limited by the scar and the attachment to the premaxilla, that this was the only method I could adopt. From that model

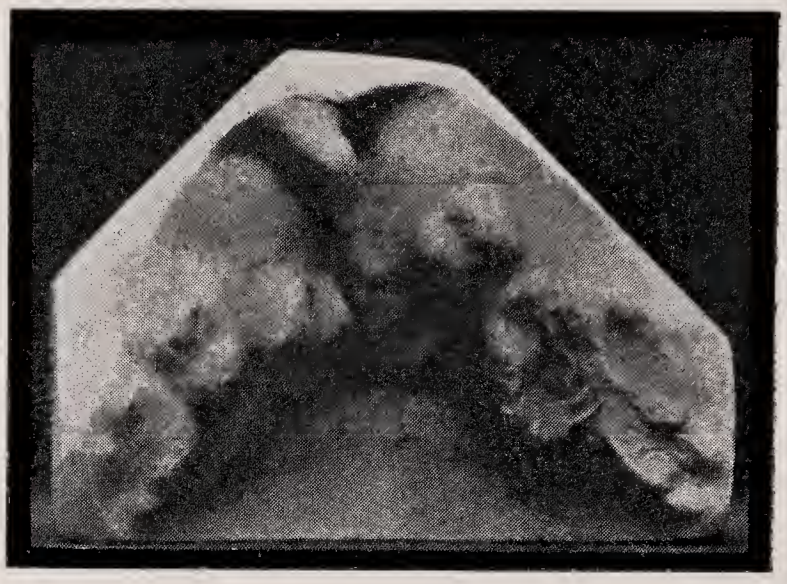


Fig. 3.

Fig. 4a.

I was able, by means of a special tray of very limited dimensions, to obtain an impression of the palate and lingual surfaces of the teeth only, at the second visit. After stretching the lip (Fig. 4a) by the apparatus (Fig. 4b), I was able to obtain a more perfect

impression (Fig. 5). It was decided to deepen the labial sulcus by skin-grafting in order to free the attachment of the lip to the

Fig. 4b

Fig. 5.

Figs 6a and 6b

premaxilla. The usual cap splint was prepared (Fig. 6a) with a detachable piece (b) to hold the "Stent" mould. A successful skin-grafting was performed by Sir Harold Gillies, which allowed

of more stretching of the lip (Fig. 7). While keeping the excellent sulcus distended (Fig. 8), I began the initial expansion of the palate. Orthodontic possibilities in a boy of this age caused me some perplexity as to the time I could safely wait and yet have time to complete a somewhat considerable expansion. As you know, these skin-grafts have to be prevented from contracting until they are well established, and the time it takes is an unknown quantity and varies with the type of individual, the quantity of

Fig. 7.

Fig. 8a.

Fig. 8b.

Prosthetic Vulcanite mould which keeps sulcus distended.

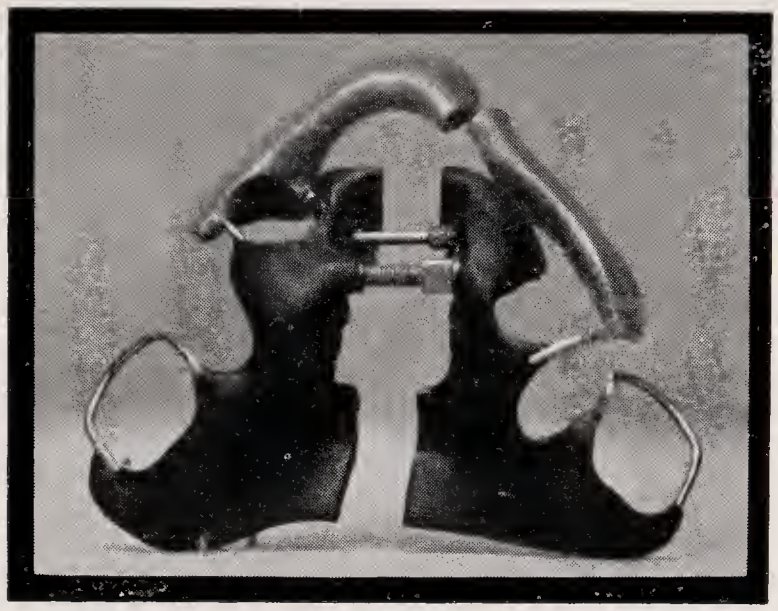


Fig. 9.

Lip, sulcus and jaw stretching appliance.

scar tissue present, and the thickness of the graft. This perplexity made me rack my brains to discover a method to do both at the same time. Fig. 9 shows the plate I devised for this purpose.

Fig. 10.

This method was used until a Badcock screw plate could no longer perform its function (Fig. 10). I was therefore forced to use fixed appliances. It is here that fixed appliances have their greatest

scope. The skin-graft was sufficiently well established, so that it was quite in order to proceed in this way. We still had to complete the expansion across the molars, and the Badcock refused to do any more. Secondly, the most important change of all, i.e. to change the shape of the arch from that of an inverted " V " into an inverted " U." Thirdly, to retract the canines.

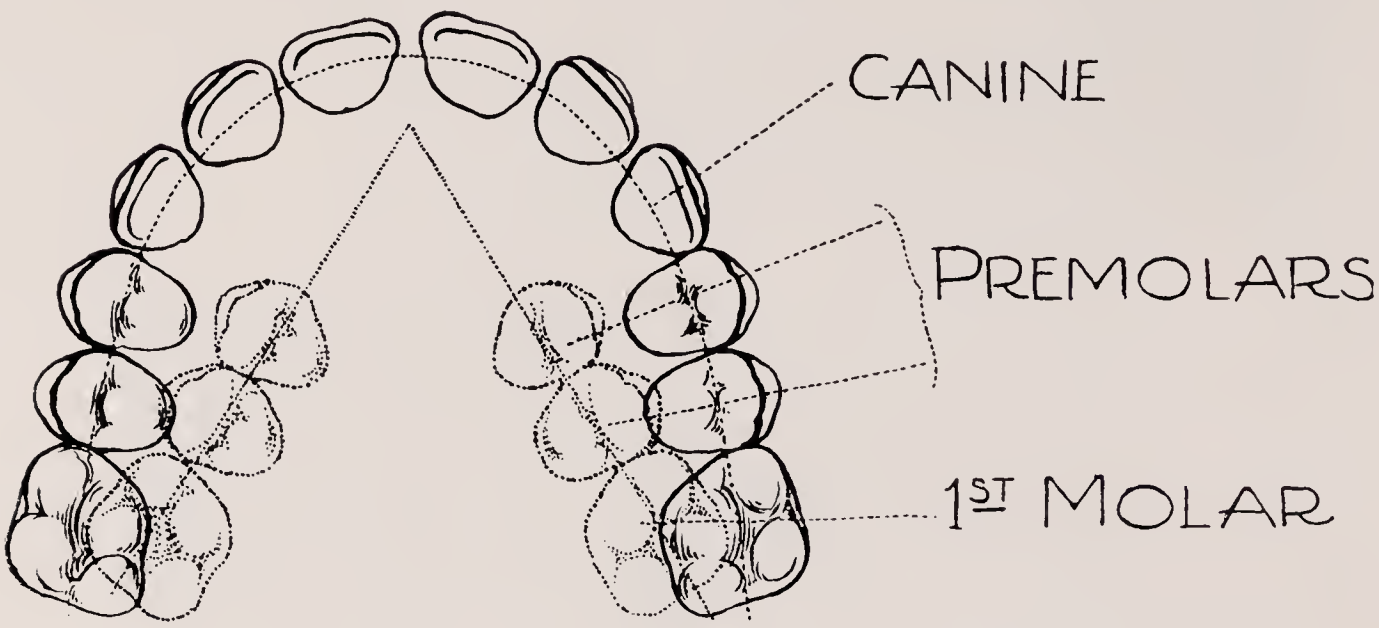


Fig. 11.

Fig. 11 is a diagram showing the normal arch as compared with that frequently seen in cleft palate cases.

Badcock screw plate expands the arch, but still retains the " V " shape, whereas the fixed appliance can stretch the whole maxillæ apart, more at the apex of the " V " than across the molars. This produces the same effect as rotation without it being a tooth movement. When one limb of the " V " has to be pushed further than the other, the fixed appliance is of inestimable value.

To Miss K. C. Smyth, who designed and made the first of the fixed appliances, I am very much indebted. I shall always be deeply grateful to her for my initiation into fixed appliance work.

Figs. 12a and 12b show the occlusion *before* treatment.

Distance between $\frac{3}{3}$: 14 mm.
,, ,, $\frac{5}{5}$: 23 mm.
,, ,, $\frac{6}{6}$: 29 mm.

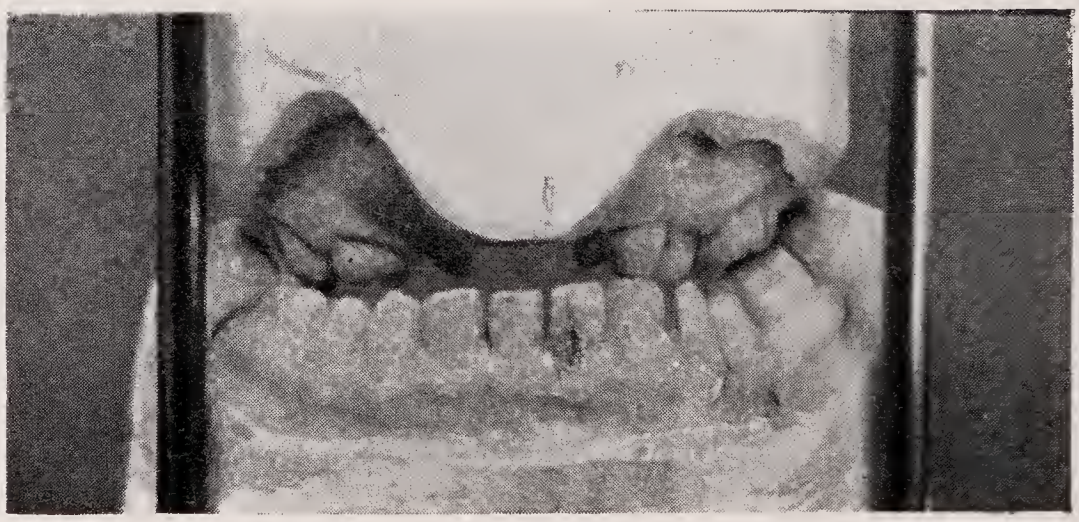


Fig. 12a.

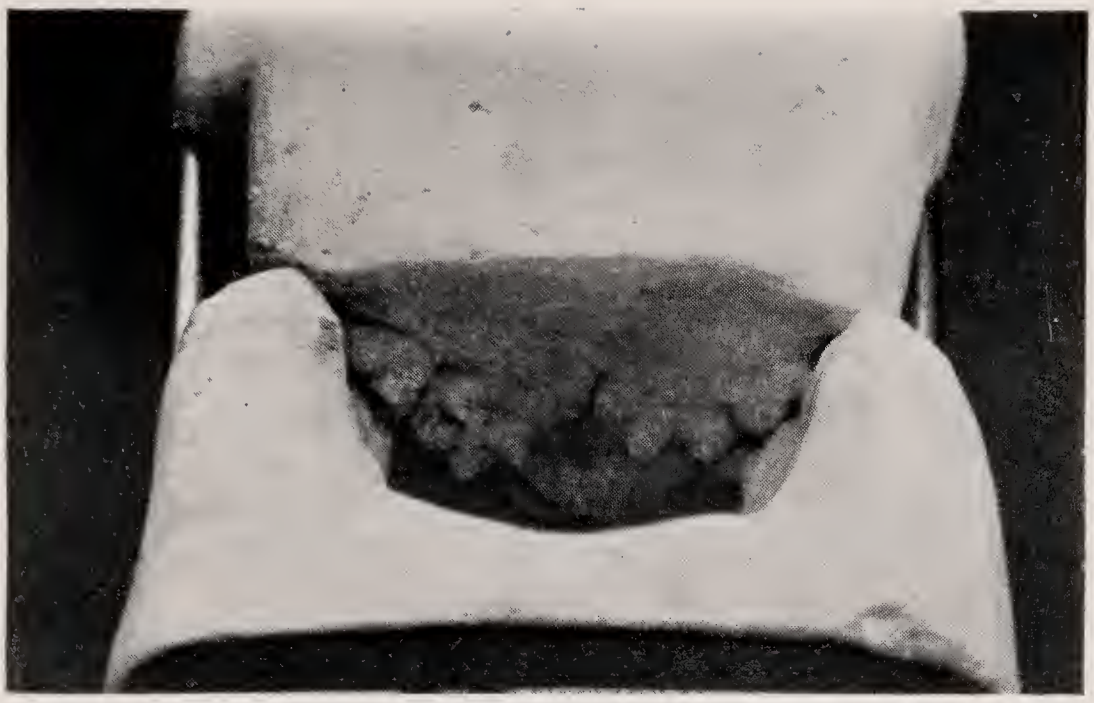


Fig. 12b.

Figs. 13a, b and c, show the occlusion *after* treatment.

Distance between $\frac{3}{3}$: 37 mm., an increase of 23 mm.
,, ,, $\frac{5}{5}$: 41 mm. ,, ,, 18 mm.
,, ,, $\frac{6}{6}$: 39 mm. ,, ,, 10 mm.

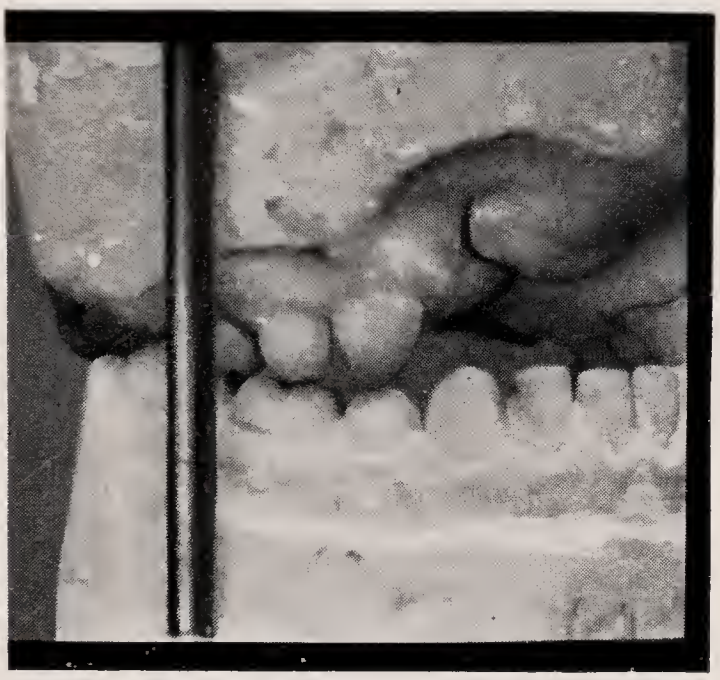


Fig. 13a.

Fig. 13b.

Fig. 13c.

Fig. 14 shows the patient wearing denture to supply 321 | 12, and X-ray before, during and after treatment.

The special points to be noted are:

(1) That orthodontic treatment *per se* improves the facial contour. (Compare Fig. 1 with Fig. 10.)

(2) That movement can take place in the maxillæ as a whole at the intermaxillary, interpalatal sutures, and the sutures between the frontal process of maxilla and the malar, nasal, lachrymal and frontal bones. (*Vide* Dr. Wright of Boston, *Dental Cosmos*, June, 1931—March, 1932.) (Compare Figs. 1 and 10.)

(3) the amount of expansion that can be gained.

(4) The tight vermilion border of upper lip can be stretched forward to its normal position and everted.

(5) The conversion of arch from that of the inverted "V" to the inverted "U."

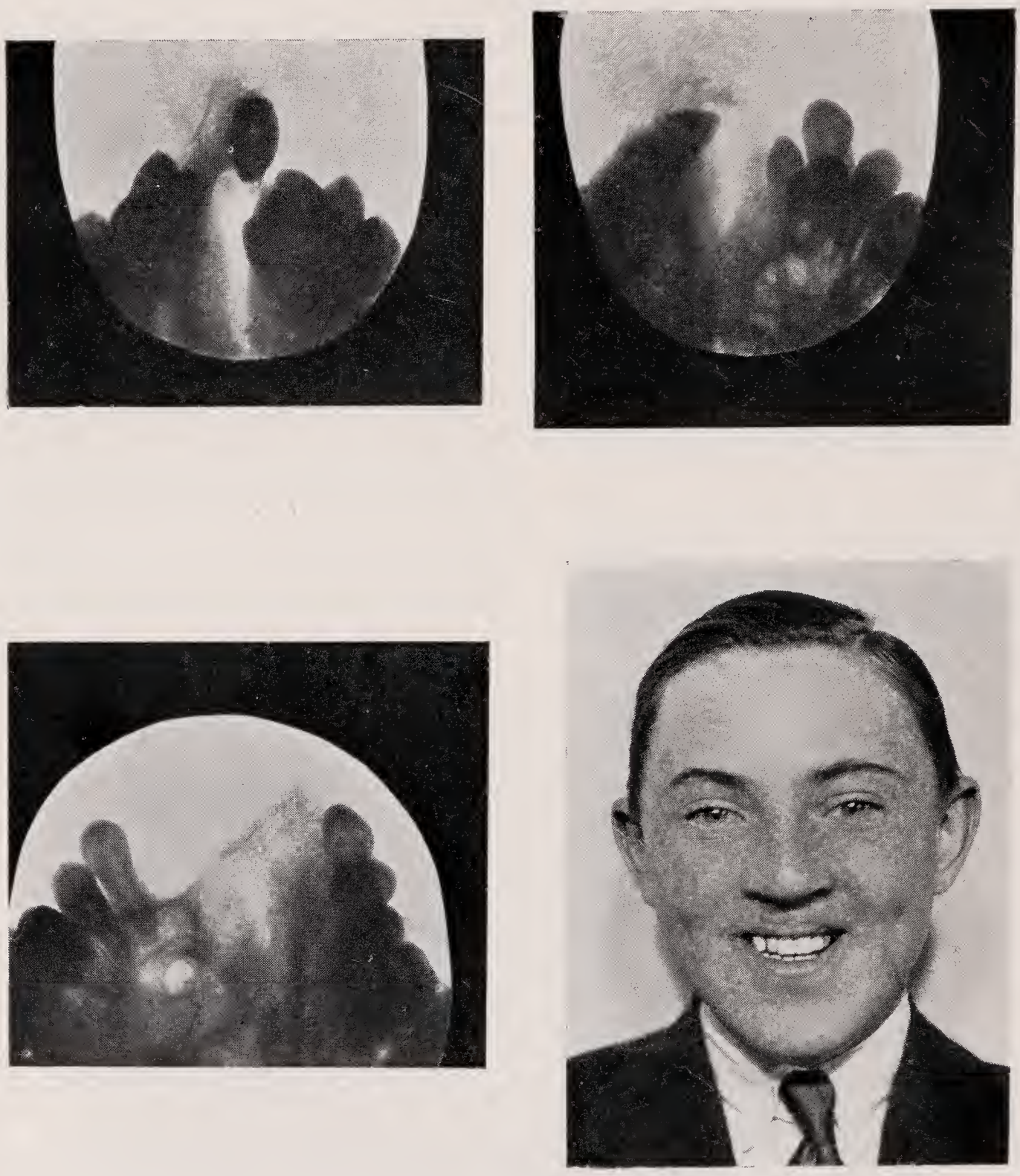


Fig. 14.

Discussion.

Mr. George Northcroft congratulated Mr. Hardy on the cinematographic presentation of his communication. It was a very interesting method of displaying any work of this kind. The case had been recorded with extreme care, and the example was one which might be followed in other carefully worked-out cases. In 1914, at the Sixth International Dental Congress, he had shown a case where he believed he had expanded the maxillary suture, using rapid expansion. Dr. Matthew Cryer, of Philadelphia, was present on that occasion, and discussed his paper, pooh-poohing the idea altogether. He himself, being younger then than he was now, was rather hurt that his ideas as to expansion of the maxillary suture should have been refuted by such an authority. It was explained that if the suture was expanded there would be a disarticulation of all the different bones of the superior maxilla, and this view in theory might sound good reasoning. In practice, however, the amount of bending at the site of the various sutures must be extremely small. Of course, in the case of cleft palate it was a little different because the bones were already collapsed, and the articulation of the palatal processes of the maxillæ would not be interlocked. He thought that Mr. Hardy had brought forward a very interesting case, and there was no doubt as to the satisfactory result of the expansion.

Mr. A. T. Pitts said that he had been extremely interested in the demonstration. He had seen a large number of these cases and had done a certain amount of orthodontic treatment on them, and had even written on the subject. He thought that such treatment had its severe limitations, and he was not so enthusiastic about it as he used to be. His experience had been that one might get what appeared to be a marvellous degree of expansion, but there was a tendency to collapse. It was not possible to get anything of a stable character. Even after years, when one had put in a denture, and the denture was left out for a day or so, the arch tended to collapse. There was no doubt, of course, that one pushed the bones apart. Seeing that all these children did have to wear a denture, there was, at the same time, a case for carrying out a certain amount of expansion which resulted in a greater degree of room for the tongue, an important matter from the point of view of speech, and helpful also to the occlusion. But he felt that the orthodontic treatment had to be subsidiary to the prosthetic treatment at a later day, and should be only taken with the idea of making the prosthetic treatment more successful. He had been particularly interested in the apparatus for stretching the lip. This was extraordinarily ingenious, and, he would imagine, efficient. It was one of the things most important in these cleft palate cases, because a denture was needed, and it had to be a denture of considerable bulk. If the lip was stretched, the patient could better tolerate the denture. He had a case of a patient who had been coming to him for over twenty years; he had a palate which was worse than flat; it was convex downwards. His upper lip was more than one inch behind his lower lip. He wore a denture, a most extraordinary object, an enormous mass of vulcanite, replacing the whole of the pre-maxilla. The palatal surface was nil. There were no bands or wires to hold it up. The patient simply kept the thing in position by his prehensile lip. Yet, when he had him first, as a boy, the lip was tightly stretched across. He did not use any lip-stretching appliance, but by using increasing thicknesses of vulcanite he had found it perfectly easy to stretch the lip almost to any amount required.

The President thanked Mr. Hardy for his communication and also for the manner of its presentation. He believed that the cinematographic method would be used increasingly by those who desired to illustrate their cases. As regards the age up to which treatment was possible, he did not think there was any age limit.

The limiting factor was the amount of work and time which the treatment occupied. The older the patient the more slowly must the teeth be moved. With regard to what Mr. Pitts had said about expansion, if one expanded the mouth and did nothing more, some artificial force must be interposed to maintain the expansion. With regard to extraction, it was a good thing sometimes to retain a tooth in the palate for the plate to rest on rather than to let it rest on the soft tissues.

Mr. E. A. HARDY thanked those who took part in the discussion and said that he was very glad to hear the President's remarks as to the age at which one could begin and finish the expansion. He inquired whether the President was referring to expansion of the jaw or just tooth movement. The President replied that he was referring to tooth movement. Mr. Hardy then asked whether in regulating the teeth the President would attempt any complete movement of the whole jaw. The reply was in the negative.

SOME NOTES ON THE DENTITIONS OF ANGLO-SAXON SKULLS FROM BIDFORD-ON-AVON, WITH SPECIAL REFERENCE TO MALOCCLUSION.*

By K. Corisande Smyth, L.D.S., R.C.S.Eng.

Introductory Note by Professor J. C. Brash, M.A., M.D.

Some account of malocclusion in the Bidford-on-Avon collection of sixth century Saxon skulls was included in the section on "Historical Incidence" in the first of my lectures on "Ætiology," published by the Dental Board of the United Kingdom in 1931. Miss Smyth had kindly provided me with a survey of the irregularities and malocclusions found to be present in these skulls; and the present paper is the fulfilment of a hope then expressed that a separate account in greater detail might later be published.

Full details of the Bidford excavations, with a discussion of the site, its relation to other Anglo-Saxon cemeteries, and of the evidence which suggests that the Bidford cemetery is to be assigned to the early part of the sixth century, are to be found in two publications by Mr. John Humphreys and his collaborators. ("Archæologia," 1924, 73, 89; 1925, 74, 271.) These papers are mainly occupied with a detailed and splendidly illustrated description of the archæological material provided in abundance by the excavations; they include plans of the cemetery, and tables giving details of the individual graves and the grave furniture found in each; there are also some excellent photographs of skeletons and grave furniture *in situ*.

Appended to each paper will be found notes on the cranial and other skeletal characters; and the only further introduction here required is a statement of the amount of skeletal material available. The total number of interments uncovered was approximately 373; of these 151 were urn burials, only 31 of which, however, were reasonably well-preserved. Of the 222 ordinary burials, the skeletal remains were found to be quite fragmentary in 42; complete skeletons, or portions of skeletons according to the degree of preservation, were thus obtained from 180 burials.

As might be expected, the majority of the skeletons are those of mature adults; yet the whole provides a complete range from infancy to "old age." It was found possible to determine the sex in 100 (57 male, 43 female). The number available for the study of the teeth is, however, much less than the total number of individuals represented by skeletal remains, for the reason that in many the facial skeleton was lacking, or so damaged that it could not be reconstructed.

* *Transactions* of British Society for the Study of Orthodontics, 1933.

Apart from all other evidence, the conclusion is inevitable from a consideration of the total number of interments, with the age and sex distribution of the individuals represented, that we are dealing with the burial place of a community. In the absence of evidence, however, of the length of time during which the cemetery was used and of knowledge of the probable death-rate, it is not possible to estimate the size of that community.

It should be added that the Bidford collection is preserved in the Anatomical and Dental Museums of the University of Birmingham, where it was placed by the Bidford Co-operative Society to whom the site of the discovery belonged. J. C. B.

The examination of these skulls and fragments of maxillæ and mandibles was undertaken with a view to discovering what types of malocclusion, if any, were represented in this Anglo-Saxon community. A casual glance through the collection revealed the fact that perfection of form was not a universal characteristic of these arches, and the actual tabulated results of a minute and systematic investigation were quite surprising.

The total number of skulls and fragments which was considered fit for classification was thirty-nine, and out of these no more than five exhibited what could be described as perfectly or very nearly perfectly normal occlusion—about 13 per cent. Twenty-one cases showed some obvious form of malocclusion—over 50 per cent.—and the remaining thirteen specimens showed slight or very slight degrees of irregularity. The total percentage of malocclusion thus is about eighty-seven.

Certain features of the specimens, notably the very heavy attrition of the teeth in some cases, made it impossible to apply all the tests of normal occlusion, and also made it extremely difficult correctly to classify the types of occlusion. But very careful allowance was made for these factors in every case. The standard of selection of the normal cases was very stringent. It was similar to that employed in the selection of cases of normal or ideal occlusion in children used for the investigation recently completed for the Dental Committee of the Medical Research Council, and is described in the special report referring to this.

Professor Brash[1] has discussed the historical incidence of malocclusion with special reference to Sir Arthur Keith's pronouncements on this question. It is therefore interesting to compare the incidence of malocclusion in these sixth-century skulls with the incidence observed in those of other periods. In 1925 Sir Arthur Keith[2] stated that " every fourth or fifth child or adult we examine possesses a palate which, compared with the older type, may be described as both deformed in shape and reduced in size." At one time he examined twenty students of the London Hospital and found that ten of them showed a greater or less degree of irregularity. Sir Arthur's most recent general estimate is that there is some degree of contraction of the palate and irregularity of the front teeth in at least 25 per cent. of the population of these islands. From the wording of this statement it would appear that he had not taken into account the less noticeable forms of malocclusion, such as close bite and displacements and rotations

of the teeth distal to the canines. However, it is probably fair to compare those cases which he regards as definitely abnormal with the twenty-one cases of "obvious malocclusion" amongst the Bidford collection. The total number in each investigation is very small—twenty and thirty-nine—but the proportion of cases of obvious malocclusion is almost identical.

Another investigation into modern occlusal conditions was that planned by the Medical Research Council, already referred to.[3] Many thousands of children were examined in the search for a large series of cases of normal occlusion. The final percentage of cases selected was as low as six. Allowing for 4 per cent. of cases rejected for incidental reasons, the remaining 90 per cent. included all kinds and degrees of malocclusion. This is probably a reliable figure, as the numbers examined were very large and the criteria employed were very definite; it is perhaps not entirely a co-incidence that it tallies so closely with the percentage figure for malocclusion in the Bidford collection, selected by the same observer working with the same criteria as far as possible. It is interesting to remember that in the one case the search was for normal or ideal conditions, while in the other case the study of malocclusion was the object.

Extensive observations on ancient skulls are rare, and those that exist do not seem to take account of any of the finer points of occlusion, but confine themselves chiefly to the shape of the palate. Sir Arthur Keith's comment upon his comparison of fifty pre-Norman skulls with fifty modern skulls is as follows: "Amongst collections of modern skulls we see teeth, jaws and faces as robustly and symmetrically developed as in ancient times, but they occur in a decidedly diminished proportion." To quote Professor Brash on this point, with reference to the Bidford skulls: "Although the frequency of some recognisable malocclusion is very great in the Bidford collection, yet the average *degree* of malocclusion is not nearly so great as in modern British people, and it consists to a considerable extent of irregular positions of individual teeth. On the whole the palates of these Saxons are notably broader than the average modern English palate."

One more quotation will be sufficient to indicate the opinion of modern experts on this point of the historical incidence of mal-occlusion. Hellman says: "The early forerunners of modern man bear abundant evidence of malocclusion of the teeth . . . the Eskimo presents an unexpected frequency of it."

From a practical point of view, the interesting fact seems to be that, in spite of broad palates and well-developed arches, all types of individual irregularities of the teeth can and do exist. When the more gross forms of malocclusion occur, they seem to be accompanied by certain degrees of lack of bone development, of the same type to which we are accustomed in the modern individual. These gross forms of malocclusion apparently occur more rarely than in the modern community, but the Anglo-Saxon community as a whole did not possess the proverbially "perfect set of teeth." Professor Brash says that we can hardly escape from the conclusion that the causes, whatever they may be, which are responsible for malocclusion were already at work amongst those Saxons of the sixth century.

The most striking feature of the collection as a whole is the great amount of attrition of the teeth. It is, of course, not a rare condition in ancient skulls, and the sites at which the wear occurs are a matter of common knowledge, but it is interesting to note the details as they affect occlusion. Some recognisable degree of attrition is present in every specimen, although in young skulls, in which the third molars are not erupted, the wear is chiefly confined to the first permanent molars. Only eleven specimens can be said to show less than a "medium" amount of wear; in eight cases the degree of wear can be described as very heavy, or "excessive." Third molars may be worn down to flat surfaces.

In the older skulls this wearing down of the occlusal surfaces has had a profound effect upon occlusion. The "occlusal plane" is actually a flat surface, and the lower teeth, also worn to a flat plane, can slide forward as far as they like. The edges of the incisors are worn down very early in the process, so that there is no longer any overlap to check the lower teeth in their excursions forwards. The term "no longer" is used advisedly, since an overlap is definitely present in a large majority of the young skulls (Fig. 1). The "edge-to-edge" occlusion which is present so frequently in older specimens of these and other ancient skulls, and which is so often quoted by anthropologists, is undoubtedly the direct result of the wearing down of the occlusal surfaces of the teeth. In many cases the antero-posterior arch relationship has become actually prenormal in this way. In the same way it is possible for an originally post-normal relationship of the mandible to correct or improve itself as the result of wear and a consequent forward swing of the mandible (Fig. 2). It is interesting to compare this exaggerated change of arch relationship which occurs as the result of excessive wearing down of the teeth, with the modern normal series of occlusal changes as described by Dr. Friel at the First International Orthodontic Congress,[4] and on subsequent occasions. His diagrams show that exactly the same thing is occurring, but on a smaller scale, and much more gradually (Fig. 3). Dr. Friel has always insisted very specially upon the necessity for physiological wearing down of the deciduous teeth in order to allow for the normal forward movement of the mandibular teeth in relation to the maxillary ones. Certainly the fact that such a great amount of wear does take place even early in life in these Saxons, seems to be one of the reasons why a prenormal relationship is so much more common that a post-normal one.

Another effect of heavy wear is to destroy the contact points of adjacent teeth. The teeth then commence to move individually, influenced no doubt by mastication. Severe rotations occur in this way.

In several specimens the attrition has been sufficient to expose pulp cavities. It was fortunate for the members of the community that in most cases of heavy attrition there was a definite reaction of the pulp, evidenced by solid deposits of secondary dentine.

Abnormalities of antero-posterior arch relationship are probably the anomalies of the greatest orthodontic interest. The relationship could be ascertained in only twenty-five of the cases. There is only one case in which full bilateral inferior post-normal occlusion

can be actually demonstrated, with protrusion of the maxillary incisors (Fig. 4). Every indication of post-normality of the mandible is present. The incisors are not only severely crowded, but they are in supra-placement, with a marked degree of close bite (Fig. 5). This case would presumably fall into Angle's Class II, Div. I.

Fig. 1.—Young skull, showing overlap of incisors.

Fig. 2.—Change of antero-posterior relationship associated with wearing down of teeth. *(Illustration by courtesy of the Dental Board.)*

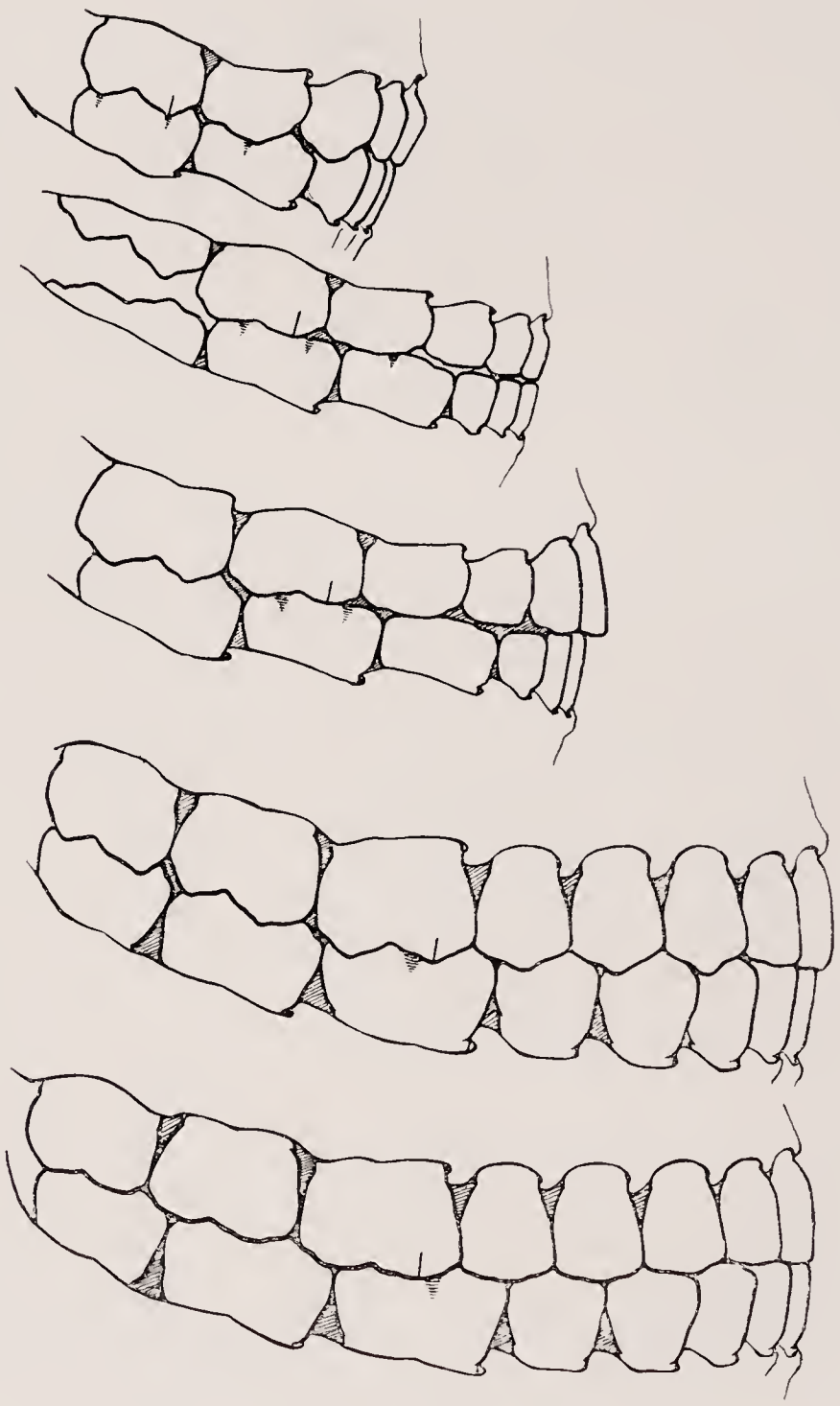


Fig. 3.—Diagram of changes in occlusion with age (S. Friel).

Fig. 4.—Inferior post-normal occlusion (bilateral), with labial inclination of incisors.

Fig. 5.—Same specimen as Fig. 4, showing close bite.

Fig. 6.—Maxilla of same specimen as Figs. 4 and 5, showing attrition of lingual surfaces of teeth.

The upper arch has a somewhat V-shaped form, and the attrition of the lingual surfaces of the teeth is very marked (Fig. 6).

In another case there is a very slight degree of post-normal occlusion on the left side (Fig. 2), while on the right it appears to be quite severe (Fig. 7) ; but on close inspection it can be seen that an abnormally small second premolar has allowed the maxillary first permanent molar to come forward unduly, and exaggerated the post-normality of the mandibular teeth. The actual manner in which the molar has come forward and rotated can be seen well in the occlusal view (Fig. 8). This is a case corresponding to Angle's Class II, Div. 2, as the retrusion of the maxillary central incisors demonstrates.

The canines, instead of being placed labially, as they usually are in this type of case, are seen to be in an unusual position of

Fig. 7.—Inferior post-normal occlusion, with lingual inclination of central incisors. (*Illustration by courtesy of the Dental Board.*)

Fig. 8.—Same specimen as Fig. 7, showing abnormally small right maxillary, second premolar, with medio-lingual rotation of first permanent molar on same side. *(Illustration by courtesy of the Dental Board.)*

medio-lingual rotation, with a slight lingual displacement also. It is a significant fact that this is the occlusion of a skull which is, to quote Professor Brash, "that of a powerfully built male." It is highly probable that the occlusion was more definitely post-normal before the wearing down of the teeth, the maxillary incisors in particular, took place.

Four cases show unilateral post-normal occlusion, not of a severe degree. One of them has a maxillary arch which is narrow in the premolar region—a "saddle-shaped arch." This case also shows marked rotation of the right first permanent molar; there is a marked degree of close bite, with supra-placement of the mandibular incisors. One of the remaining three cases of unilateral post-normal occlusion cannot be classified for overlap, as the lower incisors are absent, but shows marked labial inclination of maxillary incisors (Fig. 9). The remaining two cases both have an overlap of the maxillary incisors, one to a marked degree.

Before leaving the question of post-normal occlusion, a maxilla will be shown which has no mandible (Fig. 10). The occlusion, of course, cannot be ascertained, but here is an example of the V-shaped upper arch, narrow in the canine region, and with medio-lingually rotated first permanent molars.

To recapitulate, we find, amongst twenty-five specimens, six cases of post-normal occlusion, three of which show marked close bite, two protrusion of maxillary incisors, another retrusion of maxillary incisors. The saddle-shaped arch and the V-shaped arch are both represented, with good examples of molar rotation.

Inferior prenormal occlusion, as distinct from ordinary forward movement as the result of wear, can claim only two cases out of the twenty-five, and even one of these might be simply an exaggeration of the usual amount of forward swing of the mandible. This

Fig. 9.—Unilateral inferior post-normal occlusion, with labial inclination of incisors.

case, however (Fig. 11), shows a definite inferior protrusion. "Edge-to-edge bite" of the incisors is extremely common.

Lingual occlusion of all maxillary molars is seen in one case (Fig. 12). There is one case of a single maxillary molar in lingual occlusion.

Close bite, as has been mentioned, occurs in several cases, two being very severe.

Fig. 10.—V-shaped maxillary arch.
(Illustration by courtesy of the Dental Board.)

Fig. 11.—Inferior prenormal occlusion.

Fig. 12.—Lingual occlusion of maxillary molars (bilateral).

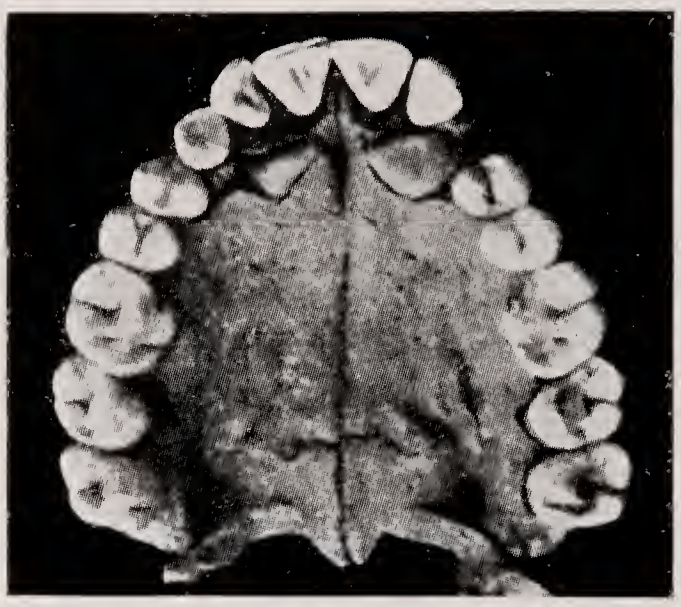


Fig. 13.—Misplaced maxillary canines.

Open bite is the only form of abnormal arch relationship which cannot be shown in this collection. The specimen seen in Fig. 18 appears to show open bite, but some of the teeth are placed incorrectly in their sockets and prevent the jaws being put into occlusion.

Individual irregularities of many kinds occur, and are classified under five headings as follows: (1) Bodily displacement; (2) Inclination; (3) Rotation; (4) Imbrication; (5) Separation.

(1) Bodily displacement: Three or four cases occur. The worst example is one in which both maxillary canines are placed in the palate, directed medially and lingually (Fig. 13). Supra-placement of lower incisors has already been mentioned. At least one case shows displacement of lower incisors (Fig. 14). This case also shows impaction of the third mandibular molar.

(2) Inclinations of different kinds are fairly common. One interesting case shows a lower first permanent molar inclined medially across a retained deciduous molar, while the second premolar is completely displaced lingually (Fig. 15). This specimen also shows a good example of caries (of which there are five other

Fig. 14.—Lingual displacement of mandibular incisors, and impaction of third molar.

Fig. 15.—Medial inclination of mandibular first permanent molar across retained second deciduous molar. Displacement of second premolar.

Fig. 16.—Maxilla of specimen in Fig. 15, showing retained right first deciduous molar, and medio-labial rotation of left second permanent molar after loss of first permanent molar.

Fig. 17.—Imbrication of mandibular incisors.
(*Illustration by courtesy of the Dental Board.*)

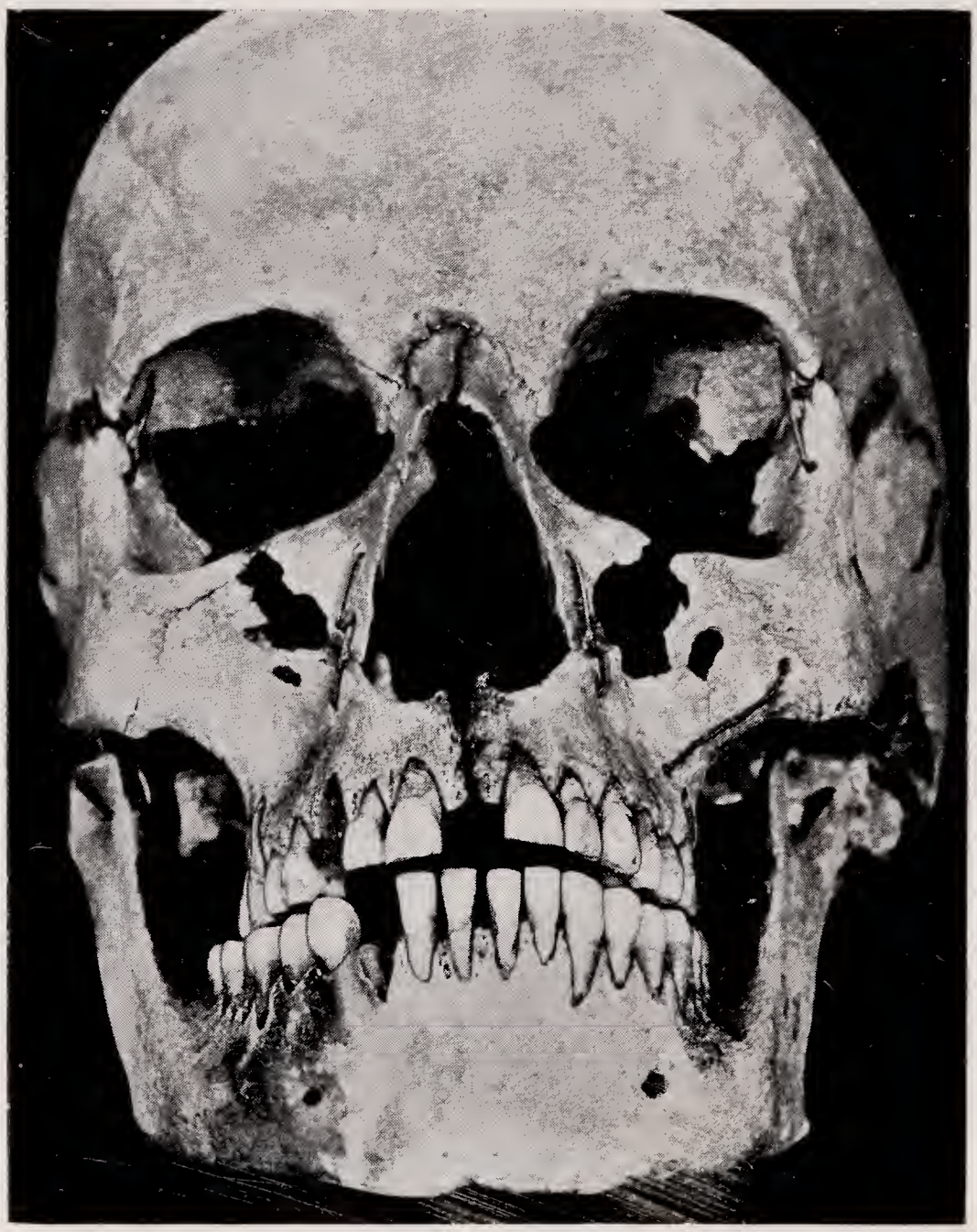


Fig. 18.—Separation of incisors.

Fig. 19.—Abnormality in shape of molars.

cases). It is one of two cases of retention of deciduous teeth. The right upper first deciduous molar of this case is also present, much worn. The other is the case of misplaced permanent canines already shown, where the right deciduous canine is still in position.

(3) Rotation is extremely common, especially of maxillary molars and mandibular incisors. Fig. 16 shows a medio-labial rotation of a second permanent molar after the loss of the first permanent molar—the reverse of the usual direction of rotation. This specimen is the one in which the first upper deciduous molar is retained.

(4) Imbrication: Imbrication of mandibular incisors is very common indeed—about thirteen cases (Fig. 17).

(5) Separation is very well-marked in one case (Fig. 18). There appears to have been no supernumerary or supplemental tooth in this, or in any other case. Another case shows slight spacing both medial and distal to the upper canines, the arches being particularly well-developed, and there are three cases with slightly spaced upper incisors.

Congenital absence of teeth. This is not a common condition, but there appears to be no premolar above the retained first deciduous molar, shown in Fig. 16, and in one or two cases lower third molars appear to be absent, but this has not yet been verified by radiographs.

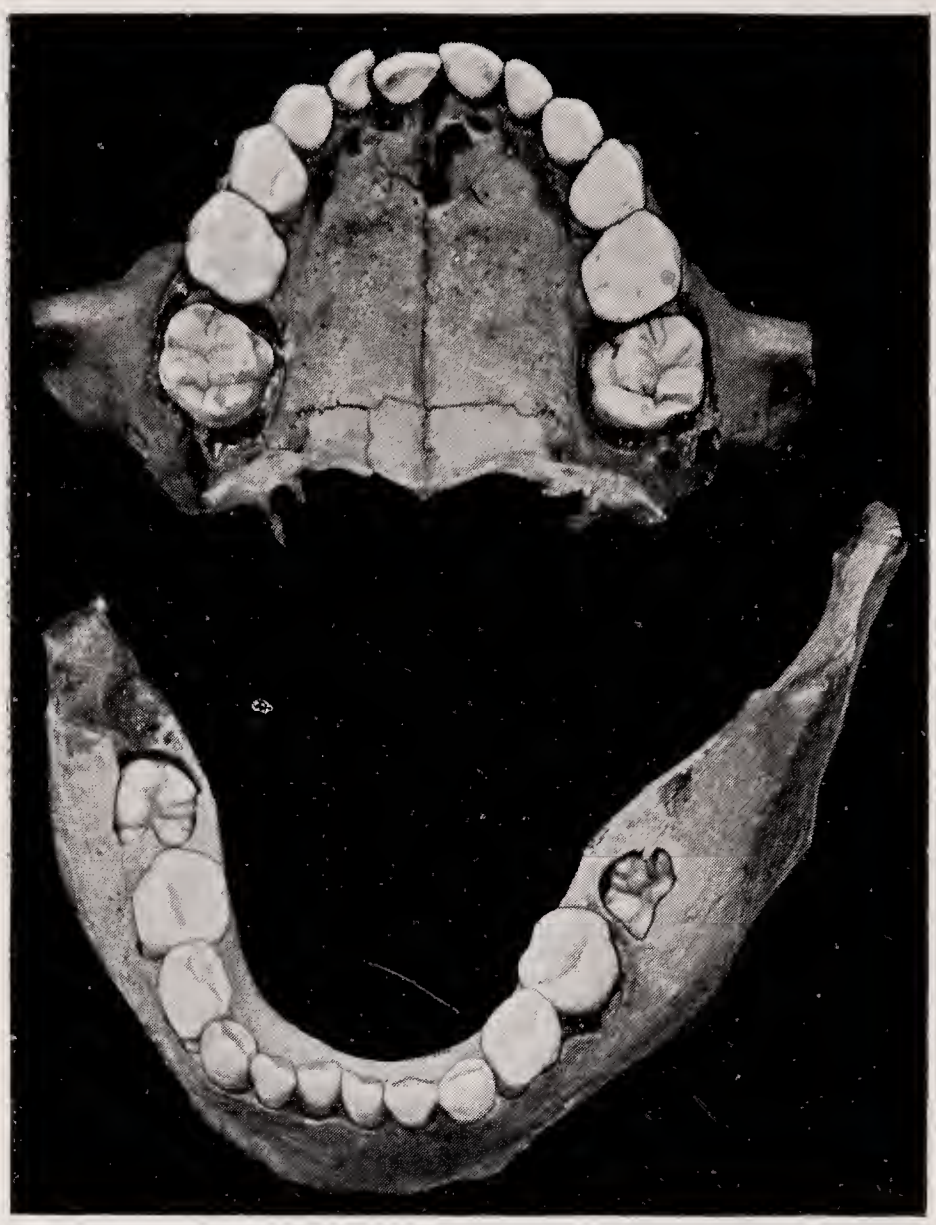


Fig. 20.—Irregularity of deciduous incisors.

Fig. 21.—Skull of child about 6 years of age, with normal occlusion of first permanent molars.

Abnormalities of shape or size of teeth are fairly common ; ten cases occur. The majority of them are teeth too small in proportion to the rest of the dentition, or with a reduced number of cusps ; two cases are upper second premolars (Fig. 8), three are molars which have a cusp less than normal. The abnormality occurs in pairs of teeth in most cases. One case has the second and third maxillary molars on both sides distorted in shape ; they are flattened medio-distally and broad bucco-lingually (Fig. 19). Two or three molars have an additional cusp.

Hypoplasia occurs in two or three cases, to a slight degree. One tooth has a peculiar invagination of enamel.

Tartar occurs rarely also, three or four cases being affected.

Caries, as has been said, occurs in only six cases out of thirty-nine. In one case there is a large abscess cavity in the bone.

Necrosis occurs in one mandible, and is very extensive. This case shows exostosis of the roots of the teeth involved in the necrosis, and also of one upper molar.

Apart from the thirty-nine specimens already described, there is a collection of maxillæ, mandibles, and fragments, belonging to quite young children. Unfortunately, hardly any of them can be put into occlusion, and many are incomplete. But thirteen specimens were considered fit for classifying for irregularities of individual teeth, and general observations. No fewer than seven of these show rotations and imbrications of deciduous or erupting permanent teeth (Fig. 20).

Spacing and wear of deciduous teeth seems to occur later than we consider to be normal. Several specimens in which the permanent molars are about to erupt show little or none of either physiological process. Only two specimens show very marked wear, and both these have the first permanent molars erupted.

One specimen in which occlusion can be ascertained, shows an interesting stage of development. The first permanent molars have just come into occlusion, in a perfectly normal manner (Fig. 21). It can be seen that the deciduous molars are worn, and that the lowers have moved forward in advance of their original relationship with the uppers. Another interesting point is the presence of an extra cusp, placed distally, on the second upper deciduous molar. This cusp appears to be helping to keep the upper permanent molar back. The relationship of the anterior teeth cannot be ascertained, as the teeth are wrongly stuck into place.

In conclusion, I should like to mention briefly another collection of skulls of very similar date to the one ascribed to the Bidford find. This is the Dunstable collection at University College, which I have examined with the kind permission of Professor Elliott Smith. Time does not permit a description of these skulls here, and it is intended to describe them on a separate occasion, but it is interesting to note that malocclusion is also found in quite a number of these specimens. One remarkable point is the number of cases in which third molars are completely absent, as confirmed by radiographs. Another point of interest is, that although irregularity of the mandibular anterior teeth is fairly common, it usually takes a different form from the imbrication of incisors which is so common amongst the Bidford skulls. The characteristic

irregularity of the Dunstable mandibles is an imbrication of the canines over the lateral incisors. This is sometimes accompanied by a marked medial inclination of the canines.

Dr. Matthew Young has written a full description of a skull of the Dunstable collection which he considers to be a representative male specimen.[5]

I should like to acknowledge with thanks the use of notes made by Dr. Friel upon some of the Bidford specimens, and to thank Professor Brash in particular for his valuable help and the loan of some photographs which have appeared in his book.[1] My thanks are also due to Professor Lockhart, of Birmingham, who kindly gave me all facilities for the preparation of most of the photographs, which were taken by Benards and Company.

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[1] J. C. Brash. "The Ætiology of Irregularity and Malocclusion of the Teeth." Dental Board, 1931.

[2] A. Keith. "Concerning certain Structural Changes which are taking place in our Jaws and Teeth; the Growth of the Jaws, Normal and Abnormal, in Health and Disease." Dental Board, 1924.

[3] K. C. Smyth and M. Young. "Facial Growth in Children, with Special Reference to Dentition." Medical Research Council, 1932.

[4] S. Friel. "Occlusion—Observations on its Development from Infancy to Old Age." *Trans.* First Int. Orthodont. Cong., 1926, p. 138.

[5] Matthew Young. "Skulls from Excavations at Dunstable," by Doris Dingwall and Matthew Young. *Biometrika*, 1933, May, Part I and II, Vol. 25, p. 147.

DISCUSSION.

Dr. G. NORTHCROFT remarked that Professor Brash, in his preliminary communication, had referred to a paper by Mr. John Humphreys. The paper was read when the society was still at Chandos Street. Mr. Humphreys had given him an opportunity of X-raying some of the deciduous dentitions which he had brought up to London: to his surprise he had found evidence of the absence of mandibular second premolars, and specimens of almost every type of irregularity known to modern orthodontists.

Mrs. R. LINDSAY inquired of Miss Smyth whether the marked separation of the teeth and the extraordinary stalwartness of the bone of the jaw in skull No. 197 did not suggest some increase in the growth of the lower jaw, possibly due to the enlargement of the tongue. She possessed a denture at Russell Square of an Irishwoman of 45 years of age with a complete dentition; the teeth of the lower jaw were much separated and the same open bite was present in front. She considered that the same condition might be the cause of the anomalies in the Saxon skull. A friend of hers had been consulted by a patient from New Zealand with the same condition, due to enlargement of the tongue.

Dr. S. FRIEL declared that Mr. Humphreys' paper had been read in 1924 when he had been president.

Mr. WILSON CHARLES remarked that it had become almost the correct thing to say that the tendency of the modern jaw to be narrow was the result of diet and of changing habit. He had been asked to examine the collection of skulls in the Royal College of Surgeons, in order to ascertain whether the third molar was missing or impacted to the same extent as it was to-day. He was, unfortunately, unable to produce figures, but he had found that the third molar was missing to an enormous extent. There did not appear to be any definite

evidence that the narrowing of the jaw which was supposed to have taken place in modern times was due to diet or to change of habit. Sir Arthur Keith, in a discussion on a paper read by Mr. Dudley Buxton before this society in or about 1920, had said that the skulls of the Bronze period showed definite edge-to-edge bite with some overlap of the incisors; that the skulls of the Roman period very often exhibited marked overlap, and the skulls of the Saxon period strong edge-to-edge bite, while in the Middle Ages, by the time of Elizabeth, we had gone back to the overlapping bite. In living primitive races at the present day—in certain African tribes, for example—it was possible to see the strongly developed jaw, the typical jaw which our forbears were supposed to have, while in another tribe, living side by side under somewhat similar conditions, but on a different diet, a narrower type of jaw was observed. One could only conclude that the question of diet had not been conclusively answered. When it was desired to produce a change in the form of a species of animals, the change was brought about by cross-breeding—i.e. by a change of environment and not of diet. It was fairly evident that the old case was not proved. The statistics which Miss Smyth had brought before the society that evening showed conclusively that the present malocclusion, while it might be more marked, was only more obvious because observers had been trained to see it. These skulls had been examined by anatomists, and, while he had the greatest respect for anatomists and did not mean to convey any unkind meaning, he thought that they would be the first to acknowledge that they were not competent to examine teeth for malocclusion in the same way as the trained orthodontist. The meeting had seen that in this one collection of skulls there existed almost every irregularity that was present in modern skulls. His own investigation into the skulls at the Royal College of Surgeons showed that somewhat similar conditions existed: the teeth were missing, especially the third molars, first molars and lateral incisors; teeth were impacted, and there was every degree of malocclusion. He congratulated Miss Smyth on her paper, and thanked her for bringing forward evidence to show that present-day malocclusion of the teeth was no new thing but something that dated back to the very earliest times.

Mrs. Lindsay said that Mr. Charles had brought up a point which needed correction. Most orthodontists present would remember Dr. Waugh's paper read at the Second Orthodontic Congress, on the Esquimaux, showing that owing to diet the jaws had degenerated in two generations into every form of malocclusion and caries. She had seen the paper again in Chicago and refreshed her memory. She had been astounded by the evidence of the models of grandfathers, fathers, children and grandchildren for every kind of malocclusion and crowding, V-shaped arches, post-normal occlusion and caries in modern Esquimaux who had gone to the coast and lived on modern tinned food, carbohydrates and soft food. The children in the primitive state had retained their primitive jaws and good arches.

The President, in thanking Miss Smyth on behalf of the society, suggested that the deciduous molar had persisted owing to non-absorption of the roots due to sepsis; it had occupied space belonging of right to the second premolar, which had been pushed into the palate. The first molar had fallen forward owing to the subsequent eruption of the second molar. This accounted for the overhang of the first molar. He had been, he said, much struck by the tremendous attrition of the teeth, which he supposed to be due to the hard diet. A number of teeth he had seen lately had suffered in the same way, being worn right down to the gum through chewing tobacco until there had been no enamel left, and the attrition had continued right

into the pulp space and the secondary dentine. It was satisfying to think that the third molar had been absent in those days, together with laterals and premolars. He had seen a patient with congenital absence of six teeth: two upper laterals and four premolars, symmetrically. The patient had otherwise been quite normal. He understood that there was an increasing absence of laterals and third molars. He thought there was a school in London which taught the existence of two and a half molars a side, and predicted that in the future the race would have two molars, two canines, two centrals, no laterals, no premolars to each jaw, a small mouth, and a large forehead.

Mr. STEADMAN asked whether the attrition, which was so very marked and interesting, was not due to sand in the food. In the War, he related, he had served on the Sinai desert and while there had examined many animal skulls. The teeth had often been worn down by attrition in much the same way. He had sent several specimens home to the museum of the Royal College of Surgeons. He had not been able to examine the teeth of many natives, but those he had examined had shown attrition. Living on food cooked in the desert by the orderlies, it had been impossible to avoid eating sand; every mouthful had given a gritty feeling, and many members of the unit had begun to suffer from worn-down cusps. He did not know whether the climate of England had altered since the seventh century.

The PRESIDENT suggested that the Saxons had milled their wheat with stone rollers and that grit had got into the bread.

Miss SMYTH, in reply, said that her own impression of the date of Mr. Humphreys' communication was that it had been delivered in 1924. She had a very dim recollection of it, and had joined the society at the end of 1923. She said that she would be very interested to see Dr. Northcroft's X-rays, as she had not radiographed the Bidford specimens. She had not any means of ascertaining what conditions had prevailed in the owner of the skull upon which Mrs. Lindsay had commented, but considered that he had very probably suffered from enlarged tongue. She had seen cases, particularly in the lower arch of mouth-breathers, where the tongue dropped to the floor of the mouth, making the lower arch wide and leaving the upper arch without its normal stimulus to growth. She could not feel sure that the specimen to which Mrs. Lindsay referred was a case with open bite. Some of the molars had been incorrectly stuck in and she had not dared to alter their position, and so had not been able to put the mandible in correct relation with the maxilla. Otherwise, she thought, it would have been an ordinary case of edge-to-edge occlusion. The teeth had all been worn down, and if it had been a case of open bite there would not have been so much wear of the incisors. She remembered Dr. Waugh's paper with great interest, especially on the point of diet in relation to attrition. The whole subject of attrition seemed to be bound up with diet. She proposed to inquire into it, and begged for enlightenment on the diet in use at different periods of history. She had no idea of the diet of the Anglo-Saxons whose skulls she had examined, but during the discussion it had occurred to her that there might be a difference in the type of the attrition of the Esquimaux and the Anglo-Saxons. Mr. Steadman had definitely been able to trace it to the sand in the food. With the Esquimaux grit did not seem to be a factor, but the attrition was more probably caused by tremendous muscular action on very tough food stuffs. A different kind of attrition would be produced from that of sand; little muscular movement would be necessary to wear teeth down if the food contained grit, but a tough substance, like chewing-gum, would require very strong muscular action. Miss Smyth expressed great interest in Mr. Charles's investigation, and asked whether he knew of any other collections of

skulls in which overlap of upper incisors, impaction, absence of teeth, and irregularities were all represented. Professor Brash, one of the most famous anatomists in the country, would be the first to say that he did not consider himself or any other anatomist qualified to make detailed observations on occlusion, and would always call in a dental surgeon to do it for him. Concerning the President's remarks on the deciduous molar, she considered that the explanation was a likely one. Her observations and those of Mr. Charles pointed to the third molar being less frequently absent than it had been in ancient days. The number of cases of absent molar in the Dunstable collection was surprising : eight or ten cases of absence of both lower or both upper molars, or one of each in thirty or forty skulls. She doubted whether in a group of persons nowadays one would find as many as ten cases of absence of both molars. She had found no cases of absence of laterals.

The meeting passed a hearty vote of thanks to Miss Smyth for her paper.

MALOCCLUSION ACCENTUATING A FACIAL DEFORMITY.*

By Robert Cutler, M.R.C.S., L.R.C.P., L.D.S.,R.C.S.Eng.

In the place of Mr. Cregan, whose communication is unavoidably held over until a later date, I am bringing forward a very simple case from the Children's Department of Guy's Dental School to occupy your attention for a very few minutes this evening. It shows how an original malformation of the jaws may be exaggerated in its outward facial appearance by the manner of eruption and articulation of the corresponding teeth, so giving rise to a general facial ensemble that, in a girl, cannot be regarded as other than serious.

In these days of beauty specialists so much can be done that my friends tell me that the plain girl has now equal chances with those more happily endowed, and in such a connection the help of the orthodontist may prove invaluable.

In talking of facial deformities, we are, I think, always inclined to visualise profile abnormalities, that is, defects in the antero-posterior jaw relationships, but there is also a quite distinct group of lateral jaw abnormalities, with its corresponding anterior facial defect, which call for comment and treatment.

The models of the case under review show a relatively simple Class I case with narrowed maxilla and slightly asymmetrical mandible, neither great in themselves, but intensified out of all

* *Transactions* of British Society for the Study of Orthodontics, 1933.

proportion by the subsequent eruption of the teeth, and by the false biting posture that has naturally ensued.

Treatment of the case was by means of removable expansion appliances in the upper jaw only, these appliances being characterised by a left lateral incline designed to keep the left side of the mouth in correct occlusion whilst the right side in lingual occlusion is actively stimulated.

I know certain forms of fixed appliance are designed to bring about asymmetrical expansion, but the removable expansion appliance with lateral incline always impresses me with being the most simple and rational method provided sufficient of the deciduous teeth remain.

The second pair of models show how the case is resolving on normal lines, calling for little more than a further period of supervision and general expansion.

The photographs show the improvement in the dental aspect, although the residual jaw abnormality is still apparent. This case is one of many where simple mechanical interference at the right time may prove of inestimable benefit to the appearance, function, and dental health, and after all, what factors constitute the welfare of our patient more than these ?

Discussion.

The President suggested that one of the possible causes of such a malocclusion as Mr. Cutler had described, operated chiefly in the upper jaw. He had seen it in a number of cases in which a child had been in the habit of resting its face on its hand while studying or reading. If the deformity were on the left side, the orthodontist was on fairly safe ground in inquiring for this cause. It was of no use putting in appliances without removing the cause. He had seen appliances push a tooth out on the opposite side without improving the occlusion on the affected side.

Mr. G. Northcroft suggested that the condition occurred in many children who were too young to lean on their hands in the way the President described. He considered that the abnormality was often a developmental one and not an acquired one at all, even by such early habits as "pillowing." He inquired the age of the patient.

The President related a case in which the teeth had been quite normal and the malocclusion had appeared on the left side at 11 or 12 years of age. It had been traced entirely to the habit he had mentioned.

Mr. Ainsworth said that the appliance which Mr. Cutler had described was interesting to him as a modification of the Badcock plate. He asked why it was necessary to make the crib on the right-hand side loose, when the tooth was moving out of its place.

Mr. H. Chapman praised Mr. Cutler's apparatus as very ingenious and successful. Nevertheless, he would not have thought that the anchorage which Mr. Cutler could obtain from the lower teeth would be sufficient to bring about the desired results. The flange (on the plate), which came down to engage the lower molars, could only be operative when the child was masticating; if the plate was worn for twenty-four hours and mastication proceeded for one hour, it did not seem possible the result could be due to this part of the apparatus.

Mr. Cutler, in reply, said that some cause must exist of the nature which the President had described. He had not made inquiries, being chiefly concerned with the mechanical possibilities of the device. The age of the patient had been $8\frac{1}{2}$ years. The object referred to by Mr. Ainsworth was not a crib, but merely a wire that went round the whole of the outside, and was left free. Mr. H. Chapman had, Mr. Cutler said, raised a very good point. After all, orthodontists used inclines, particularly an anterior incline, for aligning irregularities of the lower front teeth in cases where the upper jaw was a little narrowed in the inter-canine space with some degree of close bite. The result was that the teeth straightened up, and therefore a definite impression must be made by means of an incline only. The incline was sometimes used in correcting a postural abnormality and getting a forward bite, so a certain dynamic action was to be obtained from it. It was carried the whole way along, and if the temporary and six-year molars and lateral incisors were all present and an incline were fitted along the whole side, it was probably sufficient. Mr. Chapman was correct in saying that the appliance was only functional during mastication, talking and laughing. Mr. Cutler said that he had always recommended emphatically that these plates should be worn at meal-times, and in stating that if they were not they would not act. The idea was not a new one, but had been shown him by a very distinguished practitioner, who had treated several cases with a lateral incline. Colleagues had told him, speaking of cases where one side was wrong and the other right, that it was sufficient simply to expand, relying on the articulation of cusps on the right to give sufficient extra anchorage. When, however, he had done this, he had always found that the wrong side stayed wrong and the right side became wrong.

DEMONSTRATION MEETING.*

HAROLD CHAPMAN showed a series of models of children at 6 to 7 years of age, to point out the necessity of accurate diagnosis before any treatment whatsoever is done, and to take particular notice of both jaws and their relationship to one another; also to emphasise that in cases of normal arch-relationship where there is crowding in the lower arch but none apparent in the upper arch because the laterals have not erupted, it may be taken for granted that the upper arch will be crowded later on and the treatment of the two must be considered together. It was stressed that the loss of a lower tooth, particularly an incisor, though it occurs with other teeth, in a very large number of cases allows the lower arch to become smaller, and if that becomes smaller the upper one contracts in like manner, so that the result, as regards the upper teeth, if they are all retained, may be worse than the original condition: also, that the removal of a lower tooth in cases of post-normal relationship is absolutely contra-indicated (save in exceptional cases). Those who are in doubt as to diagnosis should keep a set of models of normal arches in the same child at different ages at hand for reference and comparison.

Another series of models was exhibited to show that the impaction of second premolars, upper and lower, almost invariably begins with caries of deciduous molars allowing the permanent molar to drift a little forward: in time the deciduous molars have to be removed prematurely, with consequent further medial movement of the permanent molar which may come into contact with the first premolar, particularly in the upper jaw: other disadvantages are, rotation of the upper permanent molar and tilting and rotation of the lower permanent molar.

L. M. CLINCH.—"Bands for Incisor, Canine and Premolar Teeth."

The object of this demonstration is to show that in order to make pull-to bands fit closely to the teeth, particularly in the cervical region, certain modifications in their shape, and precautions in the fitting of them, are necessary.

Upper and Lower Incisors.—These are the easiest bands to make and the one precaution necessary (provided, of course, that the band is the correct size and not loose) is that it be pushed well down on the labial and lingual surfaces of the tooth, as when it passes over the cingulum it becomes flattened on the medial and distal surfaces and fits them closely.

Canines.—Owing to the fact that the medial and distal surfaces of the canines are convex towards the root, it is necessary to cut, overlap and rejoin a nick in the distal part of the band in order to avoid leaving a gap between the band and the tooth at the gingival margin. A shorter nick should be made at the incisal edge of the distal surface to ensure a neat fit all round the incisal edge so that the tongue cannot be irritated; this nick should be above the contact point and should not therefore interfere with the forcing down of the band on the tooth.

Material: Firth's Staybrite Steel, .005 × 5 mm.

* *Transactions* of British Society for the Study of Orthodontics, May, 1933.

Upper Premolars.—A slight festoon on the medial and distal cervical edges is all that is necessary to make these bands fit in the gingival area. It is also necessary to bend over the incisal edge of the band into the medial and distal grooves of the tooth.

Material: Firth's Staybrite Steel. .005 × 5 mm.

Lower Premolars.—Because of the marked central inclination of the buccal surface and the well-developed marginal ridges, it is difficult to make satisfactory bands for these teeth. Using a narrow band material (3.5 mm.) and festooning slightly the medial and distal surfaces so that they lie above the marginal ridge, a moderately well-fitting band results, but it is weak and not satisfactory.

LEONARD M. MARKHAM.—"The Skeletal Band: Its Application in Orthodontics."

Examination of the crown of any human tooth reveals the presence of a cone and an inverted cone. A band which can react with both cones simultaneously becomes stationary on the cones and grips the cones according to the amount of compression the band can exert. A skeletal formation of the band appears to be essential for distribution of the compression to both cones simultaneously.

Shown: Many examples of skeletal bands on various natural teeth (molars, canines, etc.).

Series models of treated cases.

Various specimen apparatus on models (natural teeth).

Patient undergoing treatment.

Patient demonstrating various apparatus.

Patient demonstrating apparatus with intermaxillary elastic traction.

AN INHERITANCE OF DWARFED OR ABSENT UPPER LATERAL INCISORS IN THREE GENERATIONS.*

By Robert Bradlaw, L.D.S., L.R.C.P., M.R.C.S.

It is generally agreed that there is a tendency amongst the more highly evolved races towards the loss of the maxillary upper lateral incisor, concurrently with the reduction in the size of the jaws.

Dwarfed laterals are exceedingly rare in the coloured races, Du Housset reporting one of the few cases on record, and indeed complete absence occurs in considerably under 1 per cent.

J. Middleton Shaw found neither degeneration in form or size, nor absence of laterals in the Bantu races, nor did Campbell, in the Australian aboriginals, or Azoulay and Reynault in the Papuans. On the other hand, according to Hrdlicka, degenerate lateral incisors occur in about 3 per cent. of white Americans, whilst Rose states that there is complete absence in 2-4 per cent. of Central Europeans and in 6 per cent. of Scandinavians.

On the facts it is reasonable to assume that the defect is blastogenic rather than somatogenic, that is to say, it is a transmitted characteristic rather than a simple failure of developmental process. Indeed, Fry holds the view that hare lip and cleft palate frequently occur in the children of women with the defect. Herbert has reported a case of a woman, both of whose upper laterals were missing; one of her children had a cleft palate on one side with the corresponding lateral missing, whilst another child had both laterals missing. Again Siemens, when investigating the subject, found no pair of similar twins where one was affected and not the other.

The case, which it is my privilege to show you to-night, is one with an inheritance of dwarfed or absent incisors in three generations. As in the other reported cases, the characteristic appears to be a simple dominant without sex limitation. Both grandparents had the defect, and of their direct descendants, there are eleven persons affected to three unaffected. Of those with the defect nine are male and two are female. The importance of these cases is, in my view, not so much because of the difficulties such cases may present in deciding the best way in which to treat them, but because they throw light on an orthodontic factor which is still insufficiently appreciated by many people.

Since DeVries, Correns and Tschermak, in 1900, drew the attention of biologists to the work which Mendel had carried out nearly forty years before, much has been done to elucidate the problems of inheritance and germinal variation.

Although it can not always be done, especially in these days of very small families, it is possible, in a large number of cases, to forecast with accuracy, how certain characteristics will be transmitted and in what members of a family they may be expected to appear.

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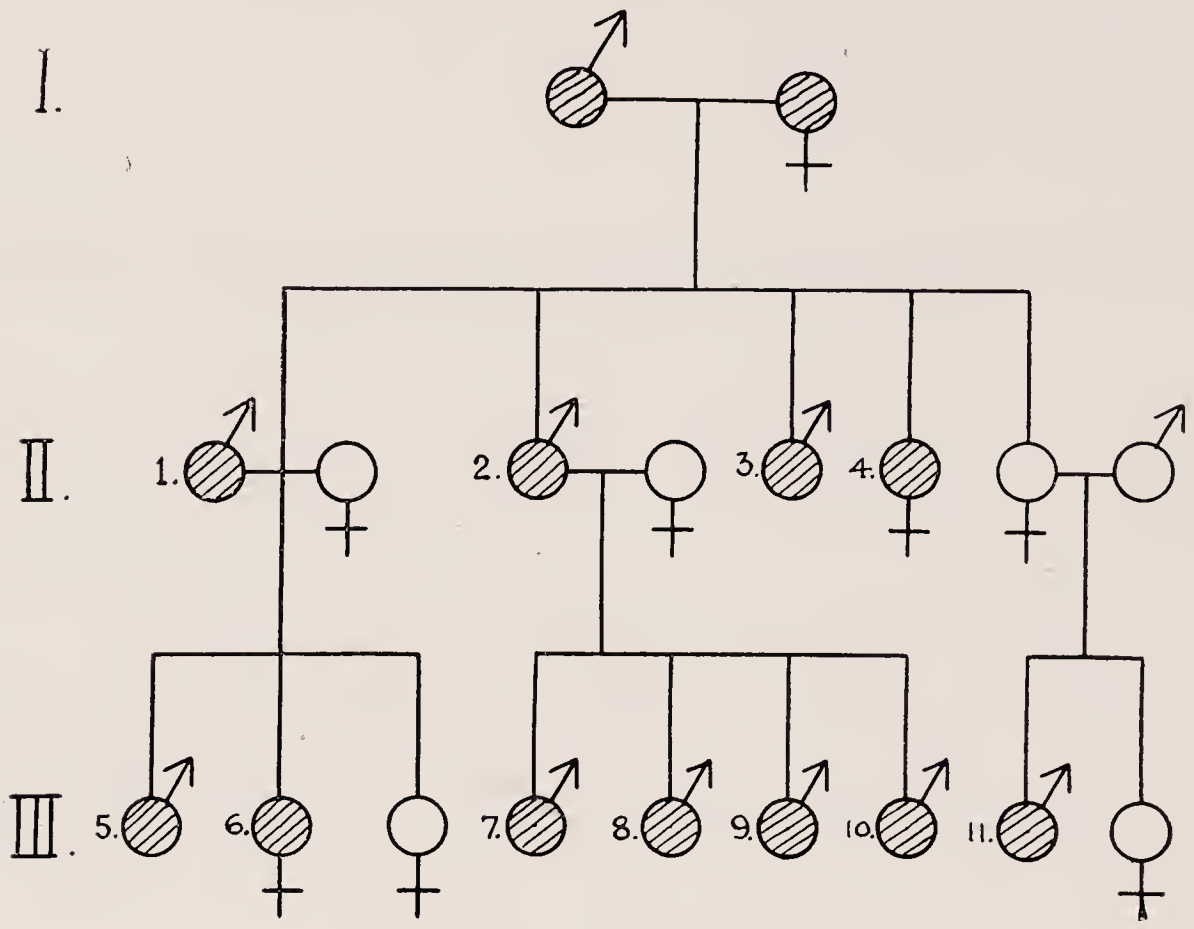
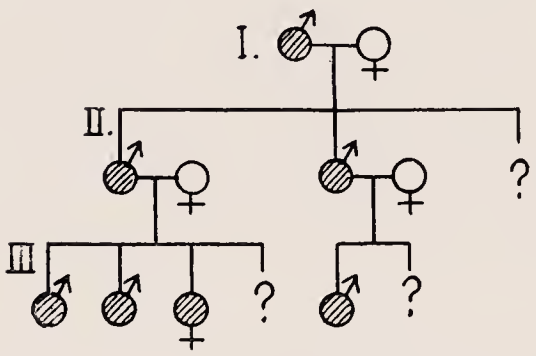
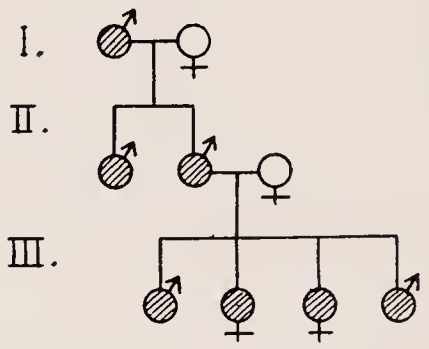
INHERITANCE OF DWARFED OR ABSENT UPPER LATERAL INCISORS IN THREE GENERATIONS.



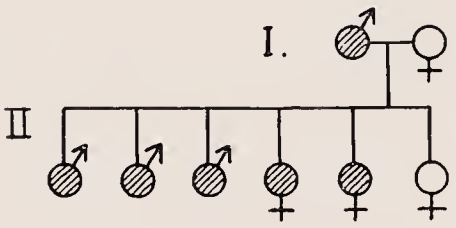
RECORDED FAMILIES WITH INHERITANCE OF ABSENT OR DWARFED UPPER LATERAL INCISORS.



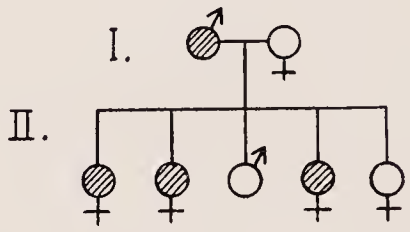
J.H. McQuillen.



Sergi's Piedmontese Family.



M. Hopson.



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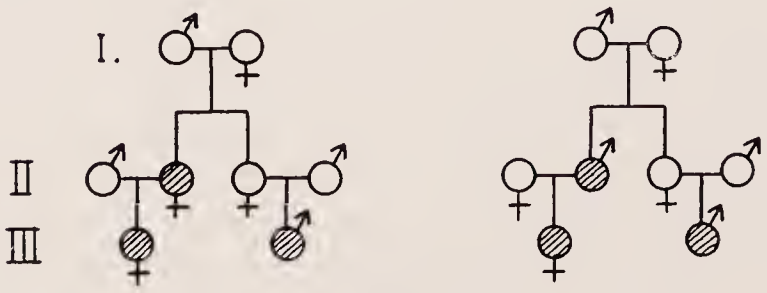

Magitot.

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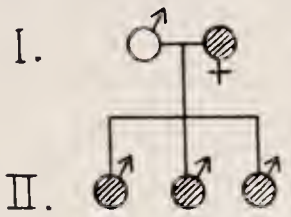
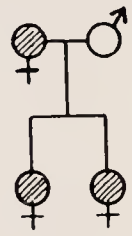
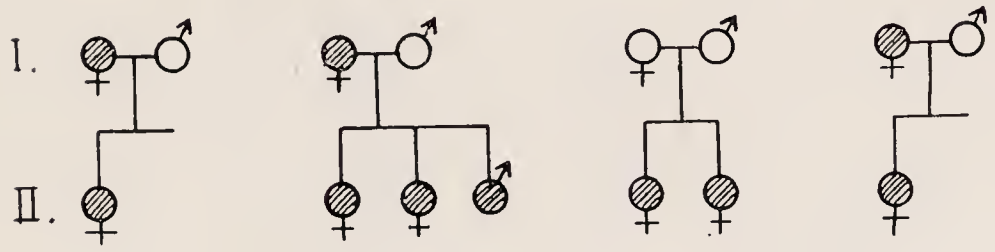


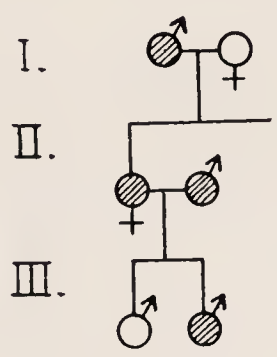
Leroy D'Etiolle.

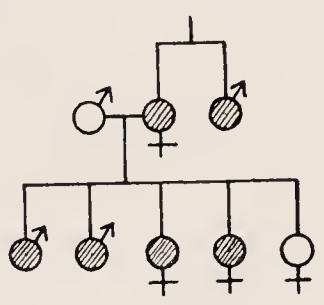


A.T. Pitts.



Windle, collected by Humphreys.



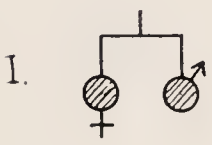


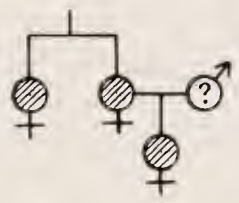
L.Levien.

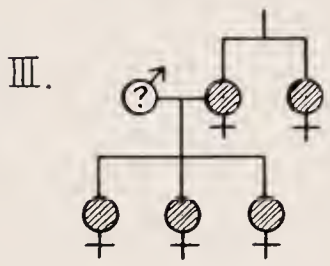
Downs.

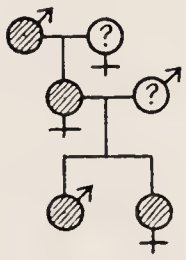
RECORDED FAMILIES WITH INHERITANCE OF ABSENT UPPER LATERAL INCISORS.

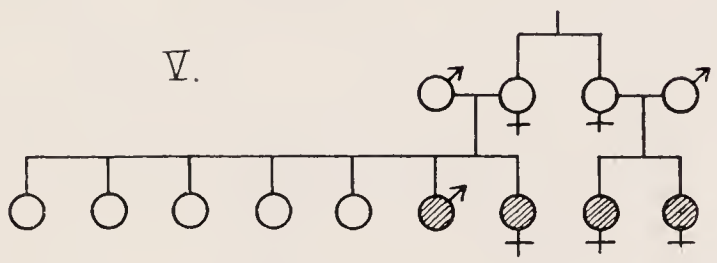
(J.H. BADCOCK.)

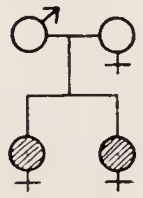


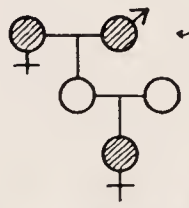


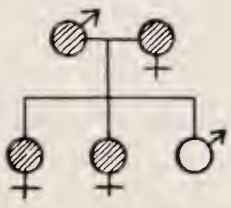


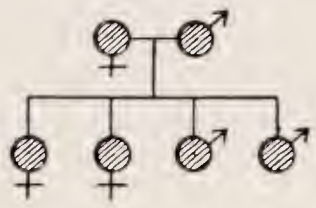






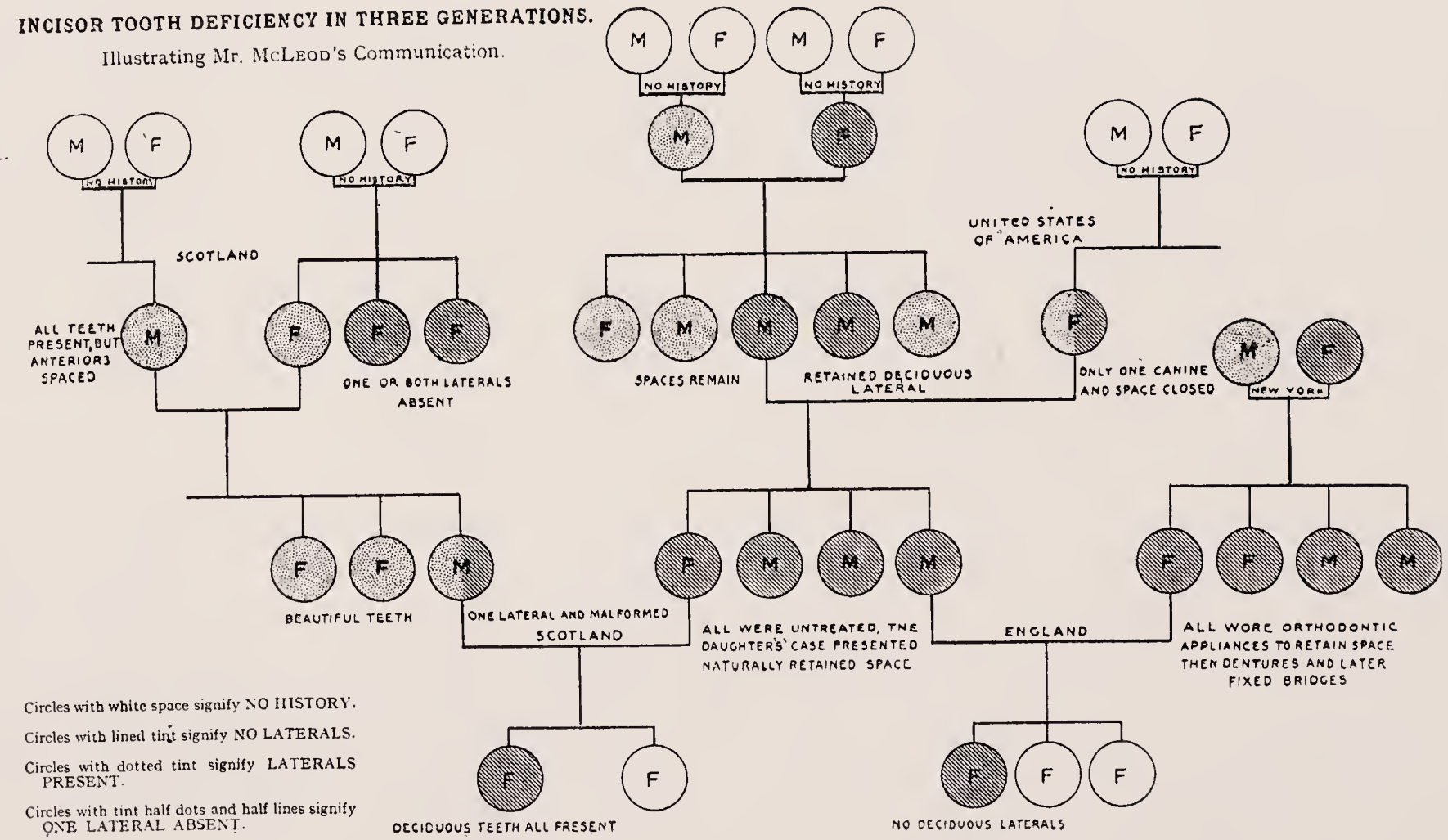






INCISOR TOOTH DEFICIENCY IN THREE GENERATIONS.

Illustrating Mr. McLeod's Communication.



Circles with white space signify NO HISTORY.

Circles with lined tint signify NO LATERALS.

Circles with dotted tint signify LATERALS PRESENT.

Circles with tint half dots and half lines signify ONE LATERAL ABSENT.

If the male and female components of the zygote, or fertilised cell, have the same tendency with respect to any characteristic, then the cell is called homozygous for that particular characteristic. If, however, the inherited tendencies are dissimilar, then the individual produced is said to be heterozygous. The tendency in one direction, however, may be stronger than the tendency in the other direction, in which case the first tendency is called the dominant, and the second tendency the recessive.

Now, from a study of genetics, we know that if a person who is homozygous for a characteristic, marries someone who is homozygous for its alternative, then the children will have a blended inheritance. Should such individuals intermarry, then the characteristics of the next generation can be worked out exactly. There will be three individuals showing the dominant type, only one of whom will breed true, and there will be one individual who will not only not have the dominant characteristic, but whose children will never have it. If, however, a person who is heterozygous for an abnormality, which is the most usual form, marries a person who is homozygous for its alternative, then half the children will be normal and half abnormal.

If two people, both with the same abnormality, marry, then three-fourths of their children will be abnormal, and one-fourth normal.

These facts are demonstrable in the case I am showing you this evening and in the very interesting sibship shown to you by Mr. McLeod earlier in the year.

In many of the recorded cases, however, the history, unfortunately, is not sufficiently complete, or the family is too small for us to recognise the force of heredity in what may appear to be the sporadic occurrence of some abnormal variation.

Discussion.

Mr. G. Northcroft said that Mr. Bradlaw was to be congratulated on the way in which he had prepared this Communication and presented it. It would be of great interest and use to members of the Society in the future, because it formed a collected record of many cases besides his own, and brought them all together. It could be added to from time to time as these cases came under notice.

Mr. J. H. Badcock said that this was an extremely interesting subject. He thought the experience of most of them was that in probably more than 50 per cent. of these cases an hereditary factor could be traced, and when this was not traceable it was very often because there was not sufficient knowledge of the family. He regretted to say that he himself had not dealt with these cases in the careful and scientific way that Mr. Bradlaw had done, and he had not complete histories, but he had put down a few notes on certain cases that had come under his notice which might be of interest simply as emphasising what Mr. Bradlaw had already said. He had one case of a man where the laterals were missing, and they were said to be missing also in his brother. Another case was that of a woman who had one lateral missing, and the same condition was found in her mother and in her mother's sister. In a family of three sisters, two had both laterals missing, and one had one lateral missing. A woman who had two laterals missing had a father who showed the same condition, as did her daughter, and, he believed, a son. The next case was that of a man in whom the laterals were missing, and it was the same with a sister and also a cousin on the mother's side. The man was one of a family of seven. Another case

was that of a woman whose laterals were missing, and whose father showed the same condition, while there was one lateral missing in her sister. Another woman had both laterals missing, and here there was a history of the grandfather and great-grandfather both having no upper laterals. In another case both father and mother were deficient in upper laterals, and two of their daughters, but not a son, in a family of three. The same sort of thing applied to missing teeth generally, and in another case the lower premolar was missing and the mother's aunt was said to have had two teeth missing. In another case, a woman, both laterals were missing, and the same was true of two brothers and a sister, also of the mother and father. In yet another case all the second premolars were missing, and the same was true of a daughter and an aunt.

Mrs. MICHAELIS said that she had come across an interesting case of a boy with missing laterals. He was the only member of his family who had that condition, but the case was interesting because the history showed that while the parents and grandparents had no teeth missing, there was an increasingly large spacing in the incisor region. Was that pure coincidence or could that spacing be leading up to an absence of the teeth ? The grandparents had a moderate spacing and the mother of the boy an extremely wide spacing, particularly in the central region. This was not one of those spacings which came on later in life, but it had been there all the time. The boy, in addition to the absence of the laterals, had also a spacing.

Mr. MAXWELL STEPHENS said that one of the past-presidents, Mr. Montagu Hopson, contributed a very interesting and readable paper on genetics to the Society's *Transactions* about 1909 or 1910.

Mr. HAROLD CHAPMAN said that it was really extraordinary that the author of the Communication should have found nine individuals in three generations, seven of whom showed this characteristic. When he was secretary of the Society he tried to get the late Prof. Sir Arthur Thomson to give a paper on heredity ; he declined the invitation, but he mentioned that one case of three generations was worth a dozen cases of two generations.

The PRESIDENT added his congratulations and asked what Mr. Bradlaw, from the practical point of view, thought of the appearance of these patients. Had he done anything to counteract the spacing due to the absence of laterals ? Had he removed any teeth in the lower jaw to balance the absence in the upper jaw ? The speaker had a case where two laterals were missing in the upper jaw and four premolars in the same patient. He took an X-ray photograph of the jaw, but found no premolar under the deciduous teeth. After extraction three months later the appearance was quite good. He thought it was a good thing to reduce the lower jaw in such cases and so allow the two arches to balance, possibly taking a little bit off the canines to make them look more like the missing laterals.

Mr. BRADLAW, in reply, said that he had been very much interested in Mr. Watkin's remark about treatment. Unfortunately, only four persons with this defect had actually come under his care ; the remaining members of the families were under the care of other practitioners. In two individuals the removal of teeth, for caries or other reasons, and the insertion of a denture, solved the difficulty, while the other two were satisfied with their appearance, so that the question of treatment did not arise. He thought that Mr. Badcock's contribution to the discussion greatly added to the value of the records made on this subject. He felt that the Society could make a valuable contribution, not only to the science of genetics, but to the science of orthodontics from the genetic point of view, by the collection of statistics of families regarding not only such a defect as this, but similar defects. A great deal could be done by careful recording to show the way in which nature worked in the production of orthodontic faults.

ORTHODONTICS AND COMMON-SENSE.—THE POINT OF VIEW OF THE YOUNGER MAN.*

By L. Russell Marsh. L.D.S.Eng.

I hope that my paper will not be a source of disappointment to you. Unlike my more talented colleagues I have nothing new to offer you, no brilliant theories and no results of years of painstaking research. What I have to offer is nothing more nor less than a point of view: the point of view of the younger man, shall we say of the rising orthodontist. It is getting rather late for me to espouse the cause of the younger man, but I hope not quite too late.

From his first introduction to orthodontics the student is both confused and depressed by a subject which never enjoys very great popularity at hospital. The number of patients applying to our teaching hospitals is far in excess of the number which can be treated, and although we try to select to some extent such cases as are suitable for teaching purposes, the claims of the more urgent and the more desperate cases cannot be overlooked. These cases range between a single misplaced upper incisor and a hopeless jumble, and in consequence the student is often working in his first few months on cases which would, and in fact do, puzzle the experienced specialist. If we were to disregard altogether the claims of the patients and carefully select our cases for teaching purposes only, it would still be a matter of extreme difficulty to find moderately simple cases with which to start and encourage the new student. Such cases seldom appear at the hospital portals. A condition of irregularity has to be pronounced before it excites the notice of the busy, hard-working parent, and reasonably desperate before that parent is willing to sacrifice the amount of personal time as well as the child's school time which are involved in a long treatment. This problem of the treatment of the masses is increasing yearly, and is one which demands our very grave consideration. Apart from its bearing on our teaching, however, it does not concern the present discussion, and so I will not dwell upon it.

Just as the selection of patients falls short of ideal so also are we handicapped in our methods of treatment and use of appliances. With due regard to the time and interest of the patient, to the skill or lack of skill of the operator and the expense to the hospital, to say nothing of the waiting list of urgent cases, it is necessary, with a few exceptions for demonstration purposes, to use the more direct methods of treatment and the more simple types of appliance, and on the whole the result is often short of the ideal. In his two years' experience the student seldom sees a case right through from start to finish, and he attains a varying, and on the average small amount of proficiency. He usually determines there and then to have nothing to do with orthodontics in his practice. If he carries out his determination this is perhaps just as well, for without post-graduate experience he might easily be a source of danger both to his patients and to himself, and his teachers have not failed if they have enabled him at least to realise his limitations. Unfortunately, however, he is often tempted in his early days of practice to undertake cases which prove to be beyond his capabilities, and his bitter experience sometimes leads him to

* *Transactions* of British Society for the Study of Orthodontics, 1933.

condemn the science of orthodontics out of hand. This attitude in the newly-qualified man has, in repercussion, its effect upon the student. It is natural for the latter to take more interest in those sections of dental surgery which are going to be a source of bread and butter later on, and in which he can see immediate and satisfying results. And so, by his lukewarm interest, he unconsciously contributes to his own difficulties in the study of a most difficult subject. We cannot criticise the student, we can only sympathise, and wish that circumstances would permit us to make the subject more interesting for him.

Let us now examine the case of the newly-qualified man who, one of a minority, considers it worth while to continue the study of orthodontics. Presumably he has been a keen student, and has put himself in the way of acquiring more knowledge of the subject than most of his fellows. As you know, the amount of work a man does at hospital depends largely on himself. Even so, his knowledge is mainly theoretical, and his practical experience extremely small. The obvious thing for him to do is to apply for a post on the orthodontic staff of a teaching hospital. Such vacancies, however, are few and far between. Let us suppose that he is unlucky. He is thus left to his own resources to acquire such knowledge and experience as will fit him to practise as an orthodontist. He attends these meetings, those of the B.D.A., and international meetings when and where he can. He hears papers and discussions on subjects which are mainly concerned with research, and shall we say advanced orthodontics, which though helpful are a little above his head. He sees a few masterpieces of finished cases demonstrated by his peers. The fact that they are masterpieces indicates that they are exceptions rather than the rule. He assumes that they are the rule. He sees also a multitude of most elaborate and beautiful appliances in which he takes an inordinate and disproportionate interest. He probably uses them without fully comprehending their dangers. With all the world of books at his disposal he lacks nothing in acquiring theoretical knowledge, and so at this stage he would seem to be well equipped with theory, appliances and optimism. This is a dangerous equipment, and with it he goes blundering on as he gradually and painfully acquires the necessary experience. Presently he begins to think for himself, and as it dawns upon him that theoretical knowledge is worth nothing unless properly applied, and that advanced appliances are valueless except in skilled hands, he realises that orthodontics after all is largely a matter of experience and common sense.

I think I ought to pause here to assure you that this is not the story of my life. But neither is it complete fiction. I seem to have raised the problem of suitable post-graduate facilities for the young orthodontist, of which there is grave need. Undoubtedly something will be done for him in the future. Meantime, I feel, and I have no doubt he feels, that something could be done for him here. He wants to know more about the elementary principles of orthodontics; he wants to know the snags and pitfalls; he wants to know what cannot be done. Let us start by showing him some of our cases that have not gone so well. He has seen all our best results and he thinks we are geniuses continually performing miracles. Let us show him some of those cases which

have presented unexpected difficulties, that have kept us awake at nights, brought early grey hairs to our temples, and made us sadder and wiser orthodontists, that he may not be the fool to rush in where we angels now fear to tread. Perhaps even the angels may derive some benefit from the discussion which will ensue.

Before showing you my instructive exhibits let us discuss a few fundamentals. When undertaking a new case, it is the duty of the orthodontist first of all to determine the condition and degree of abnormality, and to estimate so far as possible the aggravations of that condition which will develop with growth and the eruption of further teeth ; to investigate all the circumstances under which he is expected to treat the case ; to outline mentally his treatment of the case ; to visualise the result ; and to endeavour to achieve that result in the shortest possible time. From the outset this is obviously a very tall order, particularly if the patient is very young. It is often incurring a grave risk to determine at once what the ultimate line of treatment shall be, and it is sometimes wise to conduct preliminary treatment and to await further developments before making a final decision. By the word preliminary I refer to such treatment as the retention of spaces where temporary teeth have been removed, expansion of narrow arches, raising the bite, using a chin-strap in a Class III case, the removal of obstructions to correct occlusion, such as extracting supernumeraries, moving an instanding tooth, widening an upper arch, and so on.

During this preliminary stage one gets to know the patient, its behaviour and habits, the attitude of the parent, and the conditions under which one is called upon to work—a valuable asset in predetermining the ultimate treatment.

I will not ask your forgiveness for referring to that old bugbear —post-normal occlusion. It has always been a source of surprise to me that, with all the criticism levelled against Angle, no one has ever blamed him for inventing the Class II case ! Surely the proportion of failures and partial successes one constantly sees resulting from the treatment of these very difficult cases, would justify a discussion of them at every monthly meeting. To my mind, post-normal cases can be separated into two divisions— apparent and real. Into the first division I should put all those cases in which the post-normality is due to obstruction. The obstruction may take the form of a narrow upper arch or an instanding tooth or teeth, most commonly instanding canines. The lower jaw is held back forcibly in a condition, one might say, of tension, and when released by the removal of the obstruction is ready to move forward of its own accord, or with very little persuasion in the form of elastic traction or inclined plane. Such cases are often gloriously and, be it whispered, surprisingly successful. But they are misleading, and it is often impossible before treatment to distinguish them from the second division, what I call " real " post-normal cases, which presents more difficulty. (I am not considering those cases of superior protrusion in which the jaw relationship is assumed to be normal, but in which the whole of the upper teeth have travelled forward.)

In considering treatment of a case by intermaxillary traction let us examine the conditions we have to produce in order to hope for a successful result. One of our problems is to obtain sufficient anchorage to lock the jaws in their new relative position. Firstly,

we must assume a full complement of teeth. The loss of one member of either arch may be enough to wreck our ultimate retention. Secondly, we must, out of the original condition of chaos, produce two perfectly formed arches which, moreover, fit one another in their new position only. By this I mean that an upper arch which receives a lower arch in normal occlusion will obviously be too large for that lower arch in the original post-normal relationship. After this we have to apply traction to the lower arch for a sufficient period of time to develop a constant habit, to produce an alteration in the joint, or to effect whatever change we in our optimism hope will take place. During that time no single tooth in either arch must become misplaced by even a small degree, or it is liable to upset the ultimate occlusion, and with it the locking of the bite in its new position. Moreover, the tendency to relapse is very strong, and failure to wear the appliance even for a short period, whatever may be the cause, may defeat months of work. If it is true that some alteration of the joint takes place, then the traction must be started early. This means that these different tasks must be performed to some extent concurrently, and that traction—whatever form be used—must be continued over a long period in order to obtain the ultimate locking of the premolars when they erupt.

It might not be out of place at this point to call attention to the fact that there is a great difference in the conditions which obtain here and in America, from the point of view of the orthodontist. In view of racial and climatic differences our American colleagues have, on the whole, better material to work upon. Moreover, their patients and the parents are mentally more receptive to treatment than ours. Our school system also presents difficulties which tend to hinder our treatment. The town dentist is often able to see his patients only at holiday times, whereas the man who practises in a school neighbourhood loses them during their long vacations. Again, one of the worst factors we have to contend with is the condition of the teeth themselves. I think I am right in saying that caries is very much more prevalent in this country than in America, particularly in children, so that many of our cases are already mutilated before we start work. Whilst expressing my unstinted admiration for the ability of our American colleagues, I feel that these points should be borne in mind when comparing their general methods of treatment with our own.

Taking, then, into consideration all the conditions under which normally we work, with particular emphasis on the long periods during which the child is out of reach of the operator, we have to ask ourselves if we can guarantee the result we set out to perform, however hopeful the prognosis. In aiming at an ideal result, with the dice so loaded against us, are we being quite fair to the patient, the parent and the good name of the orthodontic profession, if there is an alternative treatment which would produce a reasonably fair result? I am not advocating indiscrimate extractions in all post-normal cases, but I do wish to emphasise that the operator and the parent should be aware of what he is undertaking and the possible risk of failure. For his own protection the orthodontist should, at the outset, insist upon such conditions as he considers necessary, and if these are not fulfilled, should be prepared to alter his line of treatment, or, as an extreme measure, give up the case.

Hereditary influence is a factor with which we frequently have to contend, and in this connection I am reminded of a family under my care which is very interesting from the orthodontic point of view. The eldest girl is a case of post-normal occlusion rather of the Angle's Class II, Division 2, type, though not absolutely typical; upper front teeth vertical, lower incisors slightly instanding, deep but not very deep overbite, side teeth a full tooth post-normal. This condition is associated with a prominent chin and is a family characteristic of the father's side. The result is not unpleasing, in fact, she is a very pretty girl. No doubt you have met the type of case yourselves. To my mind treatment of this case along orthodox lines would completely have spoiled this girl's particular type of beauty. I did not treat it. To tell you the truth I was not asked to treat it. But I must insist that I offered not to treat it before I was not asked to.

The second girl in this family is a case of superior protrusion, slightly post-normal, with a normal chin not particularly pronounced. She has complete absence of upper second premolar and canine teeth, and has peg-shaped laterals. These deficiencies are probably inherited from the mother's side, as the mother has one lateral missing and one peg shaped.

The youngest daughter has a hare-lip, and cleft palate on the left side involving the pre-maxilla only. The lateral was missing, and the central incisor before I removed it was lying in the cleft. Her occlusion was slightly post-normal.

A son who in age comes between the last two daughters, is, orthodontically speaking, normal in every respect.

Another family comes to my mind which may be instructive from the point of view of hereditary influence. The father is pre-normal though not to a very exaggerated degree. The mother is very definitely post-normal. Unhappily none of the five children has benefited by this union to the extent of producing normal occlusion. From what we know of heredity this is what we should expect. (The mating of black and white cats does not produce grey kittens.) Four of the children are definitely post-normal. The fifth, actually the fourth in age, is pre-normal, probably to the same extent as the father. The elder two, boys, I treated by conservative methods with moderate success. What has puzzled me about them is that in each case I have reduced the post-normality by about two-thirds. The remaining third, roughly about one-third the width of a premolar tooth, has obstinately resisted treatment. According to the known laws of intermaxillary traction, this last third should have been essential to any degree of success, as it would have meant the comfortable locking of the premolars. But there the jaws remain, greatly improved, but still slightly post-normal. It is some years since treatment was completed and there is no sign of further relapse. These two boys would make ideal demonstration cases because they always put their jaws together in normal occlusion, where they assert that the position is more comfortable, but in unguarded moments one can see that the result is not so perfect as one had hoped.

There are one or two interesting questions which arise out of these two cases. First of all there is the question of heredity. It must not be overlooked that in treating cases of hereditary origin,

one is working against the influence of environment as well, which makes it doubly difficult to overcome bad habits. It is often quite noticeable that such a case improves more rapidly after the child leaves home to go to boarding school.

The second question that comes to my mind is this. In treating a post-normal case by intermaxillary traction, do we move the lower jaw, or do we in fact move the anchorage, that is, the whole of the mandibular teeth and alveolus? Probably both, and I am inclined to think that it is the jaw which tends to relapse and the alveolus to remain, which would account for the number of partial successes, or shall we be unkind and say partial failures, to be seen in such cases. No doubt the teeth and alveolus of the maxilla also move to a small extent in the opposite direction. I am sure that many of my colleagues have met at least one case of lost chin in which, after correcting the tooth relationship, the chin still remains regrettably lost.

Now the point of view of the younger man is this. It seems clear that in many of our more difficult post-normal cases we do not really know what is going to happen as the result of our treatment, even in ideal circumstances. We can only watch the case carefully and use our intelligence and experience to the best advantage, certain only that the result will show a noticeable improvement. The orthodontist of established reputation can say to the parent, "I will do my best." If he fails to achieve a perfect result the parent is rightly convinced that no one could do more. The position of the younger man is different. He has to be more definite in his prognosis. If the case does not go so well as he hoped the parent wishes she had taken the child elsewhere, and no one is really convinced that a better result was impossible. Can we blame him, therefore, if he adopts the more definite and shorter treatment, to obtain what, even if imperfect, is at least a certain result.

I was happy to be present at the last meeting when Miss Smyth showed us some very interesting pictures of Anglo-Saxon skulls, but as I was unfortunately not able to wait for the discussion I do not know what transpired. One point, however, struck me which seems to have a bearing on the question of occlusion. A number of the skulls shown seemed, according to our standards, to exhibit a slight but very definite pre-normal occlusion. Was this, in fact, the normal condition in those times? If so we must assume that the condition has gradually altered with successive generations, that the lower jaw has in fact swung back slightly. Have we then any right to assume that the normal occlusion—not the ideal, mind you—is not actually a little further back than the position at the present called "normal."

Again if there is one thing in orthodontics upon which I have always considered one could depend, it is the size relationship of the teeth themselves, on which all rules of occlusion are based: I mean that, apart from occasional local distortions, the length of the perfectly arranged arch of lower teeth should always bear the same relationship to the length of the perfectly arranged upper arch; that the total length of all the teeth in one arch divided by the total length of the other arch should be constant. It struck me that in the Anglo-Saxon skulls the lower molars were larger in proportion to the uppers than in the modern skull.

Are we right then to assume that what is normal in one race of people living to-day is normal in another, that the normal that we assume for the German, the Frenchman and the American may be applied to that famous gentleman of the "stick-out teeth"—the Englishman? I recognise that I am not the first to express this doubt, but while the doubt exists it is bound to influence our ideas of treatment to some extent.

It frequently happens that our enemy, caries, decides the question of treatment for us, and here I would like to mention a treatment which I have sometimes found will make the best of a bad business. We have all, I imagine, met with post-normal cases in which the six-year-old molars are carious with perhaps one or two of them completely unsavable. I am going to show you a case (Class II, Division 2) in which I removed all four of the six-year-old molars (the Sacred Six) and moved back the upper premolars and canines, two by two, and afterwards the incisors into correct occlusion with the lower teeth. The upper six-year-old molars must not be removed until the twelve-year-olds have erupted sufficiently to be held in position with an appliance, otherwise the latter will move forward as they erupt. One of the disadvantages of this method of treatment is that, the first molar being absent, one is left with inadequate anchorage for a fixed appliance. It is wise,

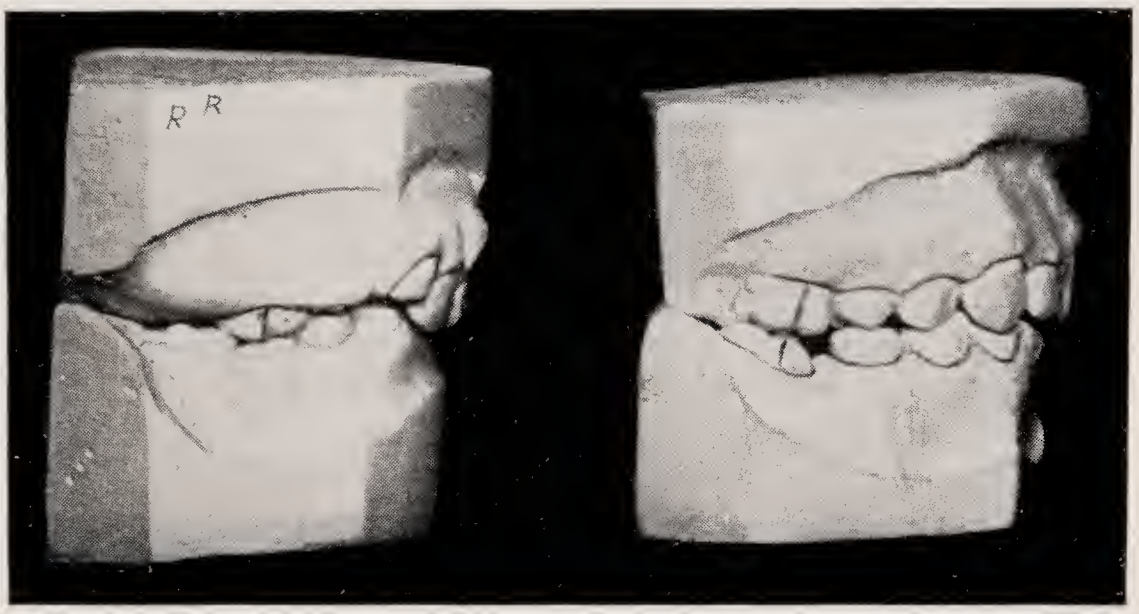


FIG. 1.

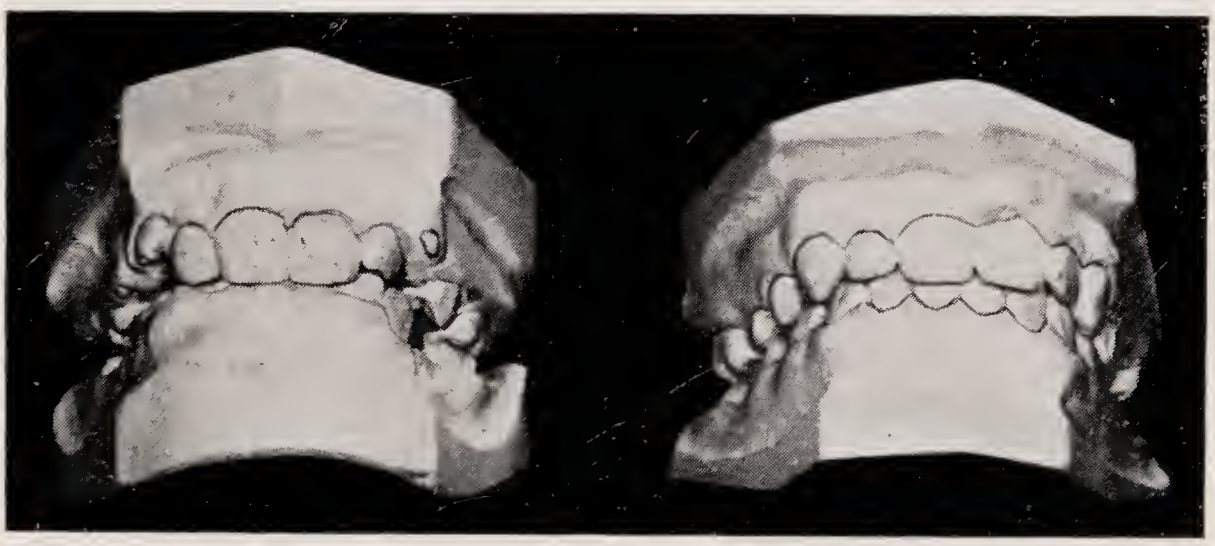


FIG. 2.

FIG. 3.

FIG. 4.

therefore to do as much work as possible before the sixes are removed and complete treatment with a removable appliance.

Figs. 5, 6, 7 show another case in which I removed the upper six-year-old molars only. As you see by the result, the upper third molars, which will probably erupt early, will complete the dentition. The lower third molars must be removed as soon as they appear, as obviously they will be functionless. I had intended to remove all four six-year-old molars, but was using a fixed appliance on the lower at the time ; afterwards it was too late, and the upper second molars had by then come into fairly good occlusion.

It is generally understood that fixed appliances operate from a fixed point of anchorage. There is no such thing as a fixed anchorage

FIG. 5.

FIG. 6.

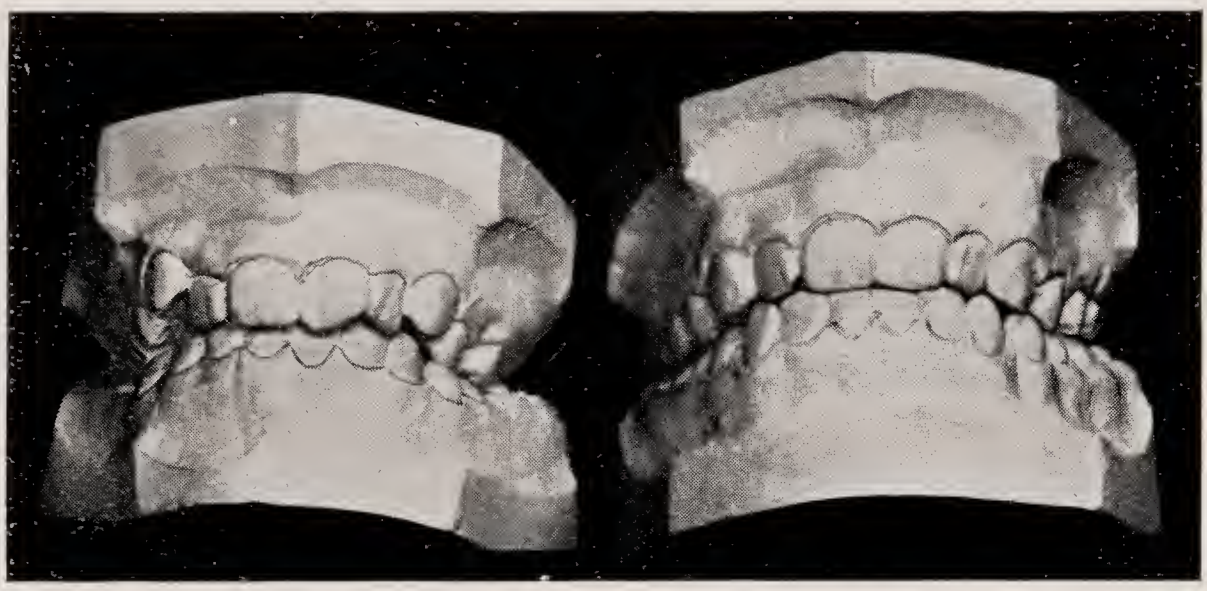


FIG. 7.

in the mouth, and the supposition that there is gives rise to much disappointment, and a sense of inferiority on the part of the operator. Anchorage in the mouth may be compared with a row-boat on a lake, the water being our anchorage, the oar our lever, and the boat the object to be moved. If the oarsman is rowing skilfully and the boat is well shaped the water gives way very little, but it does give way in some definite proportion to the force used and to the rate of movement of the boat. If, instead of the water, the boat is propelled by steadying the blades of the oars against two stone pillars the anchorage becomes as nearly fixed as is conceivable,

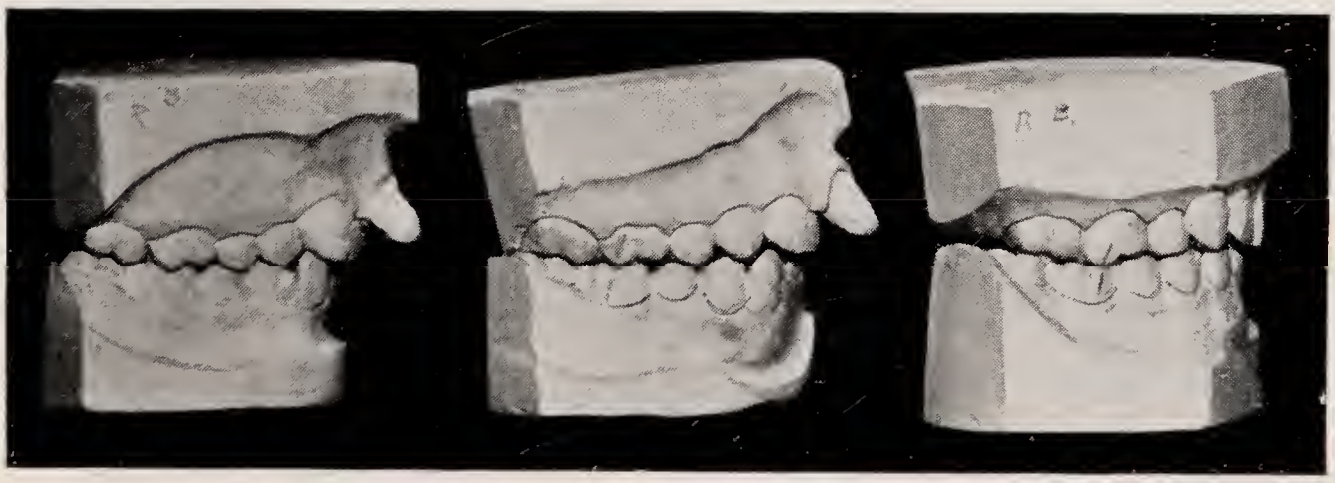


FIG. 8.

but any mathematician will tell you that even the stone pillar gives way imperceptibly according to the force used upon it. In the mouth our anchorage is much more akin to the water than to the stone pillar. This is a fact that must be recognised and duly allowed for in operative orthodontics.

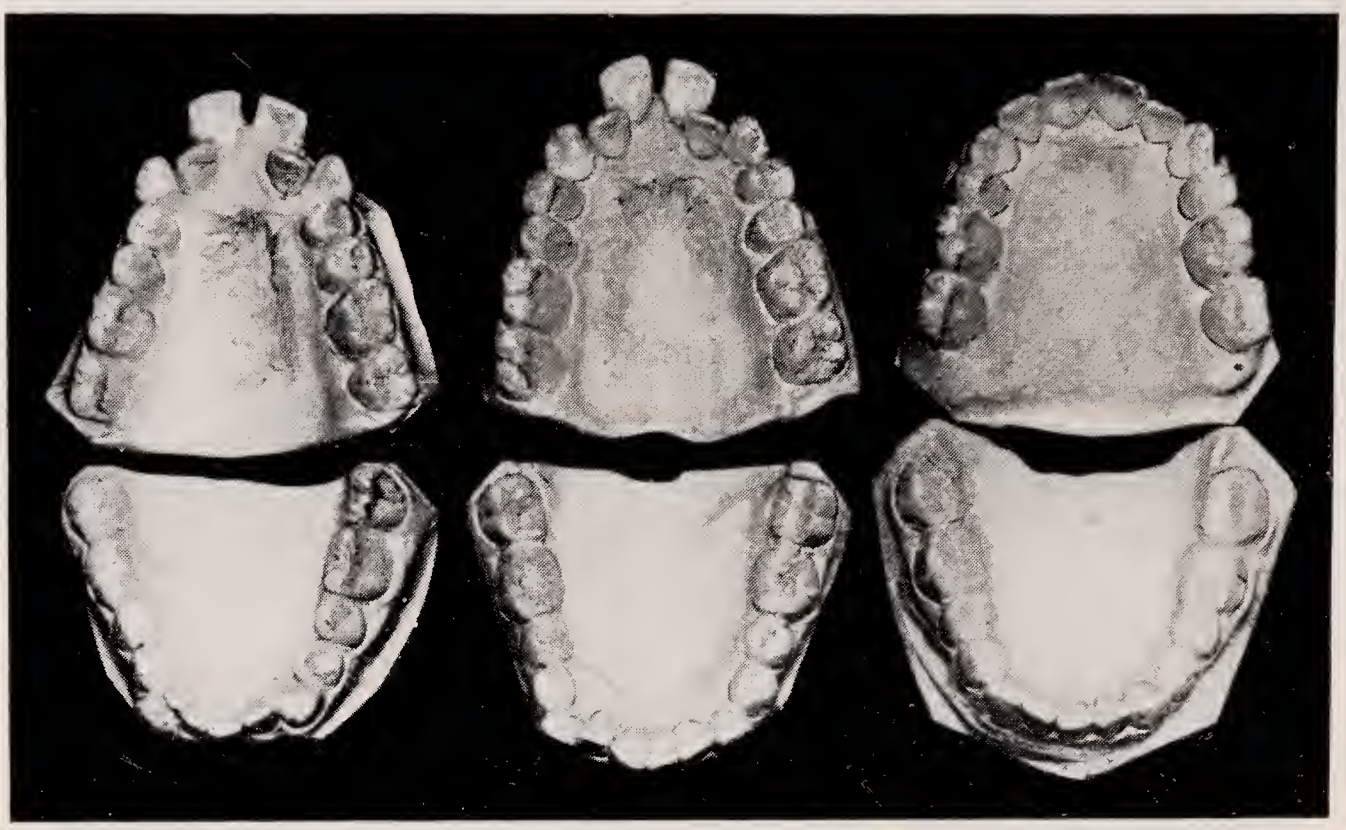


FIG. 9.

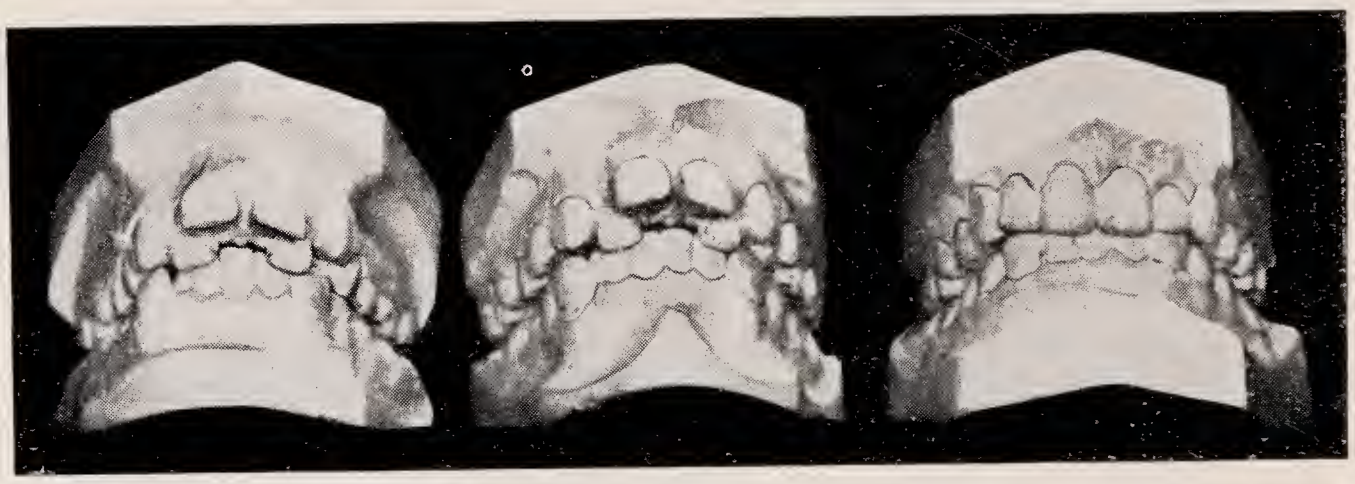


FIG. 10.

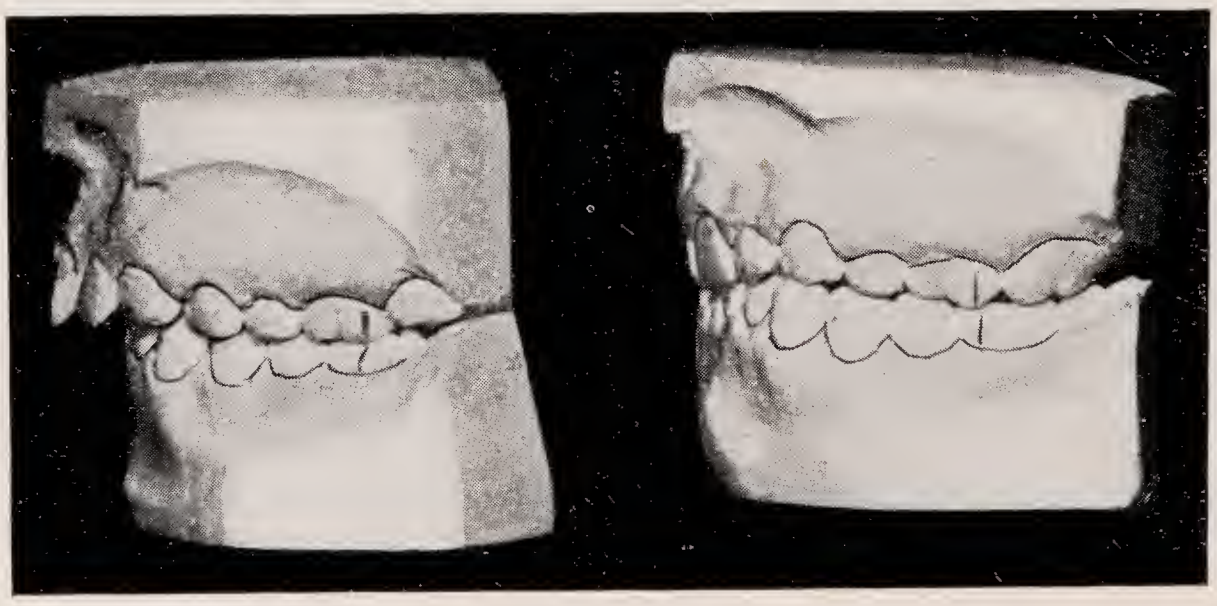


FIG. 11.

We learn by our mistakes and I am not ashamed to give you an illustration which, if it does not redound to my credit, at least serves to portray my modesty :

The patient, a girl aged 17, had an upper left canine tooth semi-erupted and completely crowded out of the arch, due presumably to early extraction of upper temporary molars. Right side, perfect occlusion ; left side, equally perfect functionally, but exactly one tooth post-normal. I removed the first premolar. The canine tooth was not sufficiently erupted to band and so I made a tiny cavity in the buccal surface and fitted an inlay, leaving the sprue in the form of a hook. From this I ran an elastic to a band on the twelve-year-old molar. If that canine tooth moved at all it was by the immeasurable amount of the stone pillar. The 5, 6 and 7 all moved forward in about four weeks and only about one-quarter of the space remained. Fortunately teeth which have recently moved fairly rapidly can be pushed back where they came from—I wonder if there is any orthodontist who has not discovered that—and this I did with a removable appliance. After that I treated that canine tooth with more respect, and by using the whole upper jaw as anchorage, managed to get it into comparatively good position. As I haven't models to show you I don't expect you to believe this, but you will readily believe that I made a hopeless mess of it at the first shot, which is all that is necessary.

Figs. 8, 9, 10 show a Class II, Div. 1, case treated by the removal of the upper first premolars and one lower incisor after expansion of both arches.

It is of interest in showing that in spite of a fair result the upper six-year-old molars have moved forward considerably during treatment. The case was treated throughout with removable appliances, and the patient was 14 years old when treatment began.

This case, Fig. 11, treated by fixed appliance, a buccal bow with cribs over the centrals to prevent upward tilt of the bow and consequent forward tilt of the molars, and elastic traction. The movement forward of the six-year-old molars is no less.

My lack of skill may be considered an important factor, but at least it was present in both cases, and it is my humble experience that the molar teeth will move to a certain extent, whatever precautions are taken, and whether fixed or removable appliances are used.

What I wish to emphasise is this : most of us do not pay enough attention to this question of anchorage, and our anchorage value is nine times out of ten grossly overestimated. Let us take for instance the six-year-old molar, our favourite point of anchorage. The prevailing tendency of this tooth is to move forward, and if the tooth in front of it is missing or unerupted, nothing but a securely locked bite will stop it from moving forward. It is impelled naturally by the bite of the opposing teeth, by the second and third molars erupting behind and by the growth of the jaw. And yet we cheerfully use it as anchorage in retracting front teeth. (In the opposite direction it is a much more secure anchorage.)

I have shown you that a semi-erupted canine is worth nearly three times a first molar when the latter is under forward tension. It would be interesting if we could make an exact table of the

anchorage value of each of the teeth in both jaws in different directions. We should probably be shocked to find that often our anchorage is weaker than the teeth we are moving, and that never is the difference between the two so great as we believe.

I think it is of great importance that the student should realise that anchorage always moves, and this movement must be allowed for—never, for instance, try to put a tooth into a space just large enough for it—and that he must multiply and reinforce his anchorage with all the means at his disposal. The Americans in their wisdom are very fond of the two upper canines and the two first molars as an anchor foundation, and I think this is very sound. Unfortunately this is usually impossible as we are more often than not moving the canines themselves.

I have tried to raise a few points which may be of interest and possibly of value to the young orthodontist. If in so doing I have appeared to dwell upon matters which to most of you are elementary, I can only apologise and offer as my excuse the title of my paper. And if any budding orthodontist after hearing me to-night goes away so depressed that he decides to give up the study of orthodontics in favour of some less exacting indoor sport, whilst regretting the loss of a colleague I can only envy him that contentment and peace of mind which we shall never know until our last orthodontic patient has broken its last appliance.

Discussion.

The President, on behalf of the Society, thanked Mr. Marsh for his excellent paper. It was a very pleasant change from their ordinary proceedings to have a little humour introduced. He thought he could agree with him from a teaching point of view that they had far too many cases to deal with. That was his own experience in Liverpool, where there was a waiting list of 70 or 80 cases, some of whom could not be touched for six months. Caries came very largely into treatment. In quite 70 per cent. of the cases it was not possible to treat them as one would like, simply because of the carious teeth. He could not quite agree with the author's experience about students not being keen. In Liverpool at present they were very keen. He agreed, as he thought they all must, with Mr. Marsh's remarks about the American nation. Evidently the orthodontists there had better mouths to work on, more bone, bigger jaws, and the retention of all the teeth was more possible than in this country. With regard to the molars moving forward, at a recent meeting Mr. Visick gave an interesting paper on stationary anchorage of molars. He had himself many a time been successful in moving the upper incisors back into the space obtained by the extraction of the premolars, and there was very little alteration in the position of the first permanent molar. It depended to a great extent on the way it was done, the amount of force exerted, and the definite upward spring which must be kept on the bow. This spring, at the same time, shortens the upper incisors and lengthens the molars and thus reduces the overbite. With regard to simple reciprocal anchorage between the upper canine and the first molar, he supposed that Mr. Marsh did not take any precautions to prevent that first molar from tilting. It would have been better, probably, if he had anchored the upper canine to the lower molars. It would have meant very little extra work, and the canine, he thought, would have gone back all right.

Mr. Harold Chapman said that Mr. Marsh had presented them with such a wide field for discussion that it was difficult to know where

to begin. He had made a passing reference, in discussing anchorage, to two pillars. The speaker would rather call them posts, namely, post-graduate and post-normal. After having conducted three post-graduate courses in three different years, in all of which there had been vacancies, he wondered whether there was so much demand for post-graduate instruction as was made out in some quarters. He had noticed in the *British Dental Journal* that the president of the Eastern Counties Branch of the British Dental Association had suggested that the Dental Board should institute courses at various towns in those counties. If sufficient students could not be got to fill a course in London, he felt doubtful whether the effort could be more successful in smaller towns, and, moreover, the facilities in those towns would be hard put to it to meet the case. With regard to post-normal cases, Mr. Marsh gave him the impression that he considered the prognosis doubtful. The speaker had come to the conclusion that the prognosis in post-normal cases was best of any, except perhaps Class III ; but he (Mr. Chapman) was probably speaking of children of younger age than the cases which Mr. Marsh had put on the screen. In a post-normal case about seven or eight years of age, treated with intermaxillary traction, one could guarantee a good result so far as one could guarantee anything. There was a possibility that the overbite might relapse, and that relapse did not show itself in protrusion of the upper incisors, but in a relapse of one or two of the incisors in the lower arch. That, however, was a minor drawback compared with the results which were obtained and no case was free from such a probability, whatever the age of treatment. Therefore his experience was not quite the same as Mr. Marsh's. He had been particularly interested in the author's remarks about the chin, because he had that day seen a child who, four years ago, was extremely post-normal. The post-normality was corrected—almost over-corrected in the circumstances—but the child continued to have a chin which was not pleasing, i.e., under-developed. He did not see how any orthodontic treatment could alter such a chin. It might be brought forward, but its shape was the same. He would very much like to know what were the probabilities of that child's chin improving—the chin, that is to say, apart from the rest of the mandible. On the spur of the moment he really wondered whether Mr. Marsh was quite correct in saying that the two arches must always bear the same relation to one another in length. He would have thought that that was not quite true, and the amount of overbite would make a difference. The greater the overbite the greater the difference in length between them. Another point which he was extremely doubtful about—though, of course, it was in the text books—was the statement that if one had a well locked upper molar, although the deciduous molar in front was removed, that molar would not come forward. He was inclined to think that that was not true. He had not any actual cases to show, but there were plenty of cases which illustrated the fact that the molars did come forward, and if he wanted to keep that space, he would certainly use an appliance to do so. He did not believe that the locking of the cusps had much to do with it ; it was effective for a short space of time.

When he was in Ireland recently, he made some remark that Class II was probably the next most common deformity to that of the normal arch relationship, and he was thereupon told that in certain neighbourhoods of Ireland the pre-normals were much more common than the post-normals. Therefore this question appeared to depend on the part of the world in which one lived. He thanked Mr. Marsh for his interesting paper, which had brought out so many points of much more than academic interest.

Miss K. C. Smyth wished to say how much she had been interested in the author's remarks about orthodontic education. She did a

small part in teaching orthodontics at the Royal Dental Hospital, and had found there that the interest which the student took depended almost entirely upon his being taught fundamentals. When she herself was a student, the teaching at the Royal Dental Hospital in orthodontics was rather patchy. There was no consecutive teaching at all; a few odd ideas were presented by different people at different times, and there was no coherent whole at all which the students could grasp. She did not think that anybody, even of superlative intelligence, let alone average, could make a great deal of a subject if it was thrown at them piecemeal in that way. But she had found that students who were of average intelligence and willing to work, *did* take an interest in the subject if it was taught them in such a manner that there was something in it that they could grasp. As for post-graduate work, it seemed to her that the Society was hardly the place for post-graduate courses. One certainly liked the Society to do all that it could for the advantage of its younger members, yet, when it only held seven meetings a year, it could hardly be expected to devote more than one or two of them to teaching orthodontics. And if some of the meetings were above the heads of the younger members, it was up to those members to get sufficient instruction in other places to enable them to take in what they heard at the Society. If a student was not prepared to pay a reasonable fee for a post-graduate course, he could not complain if he did not understand what he heard at the Society's meetings. Another point was the taking on of cases. She presumed that the author was speaking about private cases, but it was still more important in the hospitals. It was difficult to restrict the number of cases one took on at hospital. One knew of so many cases where a small amount of treatment given now would save a large amount of treatment later on. It seemed to her that this point of restricting cases was so important that it was advisable not to take on a case unless definite co-operation of the parents was assured; one ought almost to have that in writing. The author had mentioned, in connection with normal occlusion and a normal arch relationship, skulls which she had shown at a previous meeting. She had tried to point out then that the slightly pre-normal relationship associated with the edge-to-edge bite found in many ancient skulls and mentioned by various writers, seemed to be due almost entirely to the wearing down of the cusps of the teeth and the consequent sliding forward of the mandible. In the few cases which she had shown where the cusps were not worn down, a normal relationship did obtain. With regard to the proportion of the size of the upper teeth to the lower, she could easily make some measurements and find out. As to extraction of first permanent molars as part of the treatment of post-normal cases, of course one did not usually undertake this unless one was forced to it by caries, but when one was so forced she wondered whether the author supposed that there was any optimum age for such extraction. Was early extraction more favourable, or was it better, if possible, to retain for a year or two? She hoped that Mr. McKeag was present to hear what Mr. Marsh had to say about anchorage value. With regard to the extraction of four premolars and the resulting flattened appearance of the face, she had seen that very often. Almost the only type of case in which one did not get that flattened appearance was one in which there was prognathism to begin with.

Mr. H. C. Visick said that the paper was a practical one and raised a great many points. One of the few things he desired to speak about was the relapsing of Class II cases treated by intermaxillary or other methods. It was said that one sometimes got the lower incisors collapsing. Personally he had noticed a squeezing out of the lower second premolars. These, perhaps, erupted in the right place, but

later in life, at the age of about 18 or 20, they became squeezed out lingually. When the bite began to close, the lower incisors tended to slide up the back of the upper incisors, and in that way one had a squeezing out of the second premolars. The author had said that a case of post-normal teeth was often found where the lower jaw was held back by the upper canines, and that if the upper canines were expanded, the lower jaw would come forward. The speaker could not believe that a powerful moving part like the lower jaw could be kept back by a couple of teeth in the upper jaw holding it there. He remembered once before criticising a statement to the effect that post-normal cases could be treated by a movable appliance, and that induced Mr. Northcroft to bring forward a paper to confound him. It was one of the best papers they ever had, and he only hoped that this remark of his would induce Mr. Northcroft once again to write a paper.

Mr. CALE-MATTHEWS said that the paper was an extremely difficult one to discuss, and, as usual in their meetings, the discussion had gone on to individual methods of treatment rather than of general principles. He thought, however, that it was the desire of the author not to discuss individual conditions or methods of treatment so much as to illustrate by the few cases he had shown a breadth of vision whereby the young man for whom he was appealing could envisage his whole method of treatment. Mr. Chapman and Miss Smyth had spoken of the desire —or lack of desire—on the part of the younger men for knowledge on this subject. Either last year or the year before he himself put a few remarks, bearing on this subject, together for one of their meetings, which was very sparsely attended, and the discussion was very "smothering." What he did was to make an appeal for help for the newly qualified man who was anxious to acquire some information on the practice of orthodontics, and he appealed to the senior members of the Society that their accumulated wisdom and experience and skill in this respect should not be lost. There did not appear to be, however, any particular desire to make the sacrifice of time and energy which this would involve, and therefore his paper entirely misfired. One got rather tired of this appeal on behalf of the younger man if the younger man did not himself show any great desire to acquire the information which was available. They had just heard that the course given by Mr. Chapman was not filled, and it was limited, he thought, to ten students. In a dental population such as they had in London one would have thought that such a course would have been overwhelmingly filled. In Birmingham a course, under a different tutor, also in Liverpool, was projected, but owing to lack of support it was not carried through. If there was this great desire for knowledge, at any rate it was not very vocal, and yet at the same time one did feel here and there that there were some people who had not had a great deal of opportunity in gaining experience in this particular work. Why was this ? He did not know whether it was the fault of the seniors, but the whole practice of orthodontia had been smothered in mystery. There was really no mystery about it at all. Whether one was successful or not entirely successful one could get results, and in the majority of cases the result which one strove for, given time and patience and the co-operation of parents, could be obtained—at least to the extent of an improvement on what existed before one started. The idea of mystery should be entirely dissipated.

He objected to a word in the title of this paper, namely, "common sense." Common sense was one of those things which one rarely encountered, and as applied to orthodontic practice it was a very rare thing indeed. But he felt that in this country we laboured under many disabilities. We had not the courage of our convictions. We were accustomed to pay too much attention to precedent and history. We were inclined to conform to all the things that had gone before, and

lacked courage. Only that day he was talking to his students and was taking very much the same line that Mr. Marsh had taken, in the sense that they must be able to recognise the conditions which they wanted to treat. That was the primary thing they had to instil into the minds of those they were teaching. They must get rid of the shibboleth of appliances which had grown up during the last twenty years. There had come about an endeavour to accomplish everything at once, instead of taking things quietly in stages, and dealing with the difficulties as they arose. A mental tangle was developing and the more ingenious and complicated the appliances presented at an orthodontic meeting the more applause they often received. It was necessary to simplify the whole teaching, and to give the students a broader outlook, allowing them to develop their skill and gain their experience. He believed that this paper would help the younger men, and he congratulated the author on his courage in showing unusual cases on the screen.

Mr. E. E. Wookey agreed with Miss Smyth and Mr. Marsh that the subject was taught very inadequately. The result was that when a man started in practice he found himself confronted with extreme difficulties. With regard to post-graduate courses, the pity was that these were so often arranged at a time of day which was impossible for the busy practitioner, namely, the late afternoon or early evening. The fee charged was quite reasonable, but to this had to be added the amount which the practitioner lost in the way of professional fees by his attendance. That might be a reason why practitioners did not take advantage of such opportunities as they should.

Mr. G. C. Friend said that seven years ago, on joining the B.S.S.O., he himself thought orthodontics a minor branch of dentistry, but after a few months he discovered that it was much more than that. It had become a cult, almost a religion ! It had a definite creed of its own, and a very small number of high priests who alone seemed capable of dealing with its intricacies. This was very frightening to a young man like himself. But later he took an appointment at a large public school, and there had the privilege of seeing some of the cases which had been dealt with by some of the high priests of orthodontics. That cheered him considerably, for he discovered that men whom he greatly admired and who had been horrified at the idea of extracting a tooth at the B.S.S.O., were cheerfully able to remove the tooth in their own private practice. He also discovered that a large proportion of their cases were unsuccessful, and having listened to their extremely learned papers he wondered whether, in view of these results, it was really worth while to pursue the subject. In his own busy middle-class practice as a young man he felt that he must reduce his orthodontics to straightforward simple cases, avoiding as far as possible all forms of appliances. If he could make his job shorter and simpler by removing teeth he did so. In the past, orthodontics had been largely a matter for the wealthier classes, but those people were not the only ones who wanted the treatment. This treatment wanted spreading over the countryside, but he felt that if that was so the whole thing would have to be simplified.

Mr. J. H. Badcock, who was asked to contribute to the discussion, said that he had only to express his admiration for the paper. It was extremely full of the common sense denoted in its title, and it brought forward a great number of points well worth discussing.

Mr. Bertram Samuel said that in one respect he had found Mr. Marsh rather depressing, for he had reminded him of the passage of time, and of how all their work went round in a cycle, and the conditions of years gone by reappeared again. He remembered that he had written a paper in 1919 on post-graduate teaching in orthodontics, and as the outcome of that, several of them had discussed a post-graduate

school for such teaching. Nothing had come of it, and he would suggest to Mr. Marsh that he should take on the mantle now.

Mr. MARSH, in reply, said that although, to his regret, there would not be time to answer all the speakers in detail, he was very glad to have stimulated a great deal of discussion. In fact, the paper had been so thoroughly discussed that not much of it was left. Even the title had been objected to. In advancing the cause of the younger man, he had had no intention of criticising "us older men." The President had defined one or two of the problems, and he would like to congratulate him on the keenness shown by the students in Liverpool. He thought that the Society would have to move up there very soon! With regard to the retraction of the upper incisor, he did use the appliance which Mr. Visick had discussed, and he maintained that the six-year-old molars did come forward to a certain extent. Mr. Chapman had told a sad story of post-graduate opportunities not being taken up, but he thought that the fact that the course took place in the afternoons had something to do with it. A man in practice could not get away at certain times, especially about four or five in the afternoon. That had something to do with the poor attendance. Mr. Chapman had mentioned that, when using intermaxillary traction, his patients were of an early age, six or seven. The speaker would suggest that there was a difference in the case of a little patient at that age. Certainly the effects of environment were most noticeable at that time. He was not casting a doubt upon the success of treatment, but he was trying to show that they did not know whether the alveolus moved or whether the jaw itself moved. With regard to the discussion of elementary matters at the Society's meetings, he was not suggesting that the meetings should be made so elementary as to deprive them of interest for the rest of the members, but that a certain part of the time might be devoted to this serious question of post-normal treatment. Mr. Visick had referred to the squeezing out of the lower premolars. He would suggest that perhaps the oncoming wisdom teeth had something to do with that. With regard to Mr. Friend's remarks, he thought that the position was that senior men in the orthodontic profession knew very well that the younger man erred on the side of the easier method of treatment. The latter rather tended naturally to take the easier line and to extract teeth willy-nilly. In the endeavour of the senior to educate the younger man out of that tendency perhaps he erred a little on the side of conservative treatment, and thus there arose the impression that the senior men taught one thing and practised another. He agreed with Mr. Endicott that the best anchorage for retraction for the upper front teeth was inter-maxillary traction from the lower jaw. Mr. Searle had suggested that there ought to be a standard text book. One of these days the speaker was going to write a book on Orthodontics himself. He would call it, "What not to do." It would be an enormous volume, and each yearly edition would be larger than the last, as his own knowledge of the subject increased.

SOME PROBLEMS OF TREATMENT.*

By N. J. Ainsworth, M.C., L.D.S., L.R.C.P., M.R.C.S.

I feel that the Annual General Meeting is not an occasion to choose for any very solid paper. I am therefore glad to make it an excuse for presenting what is little more than a series of Casual Communications with very little connection between the various groups.

When I agreed, rather more than a year ago, to contribute a paper, I had in mind a series of cases I had treated at the Royal Dental Hospital by the extraction of a lower incisor. The immediate results of these had been invariably excellent, and for some years I was enthusiastic about this simple treatment. The later results, however, were not so good; the imbrication of the four lower incisors, which was usually the original condition, was frequently replaced by a very similar imbrication of the remaining three, often nearly as marked and unsightly, so that it seemed as if the incisor had been sacrificed for nothing. I then began to collect cases of late results of such treatment and the results seemed to confirm my suspicions.

Mr. Chapman, at the meeting of October 7th last year and again on January 16th, very effectively dealt with the question, and the point has been raised at several subsequent meetings; nevertheless, one or two points which I do not think have been stressed hitherto are rather well brought out by my own series of cases, so that I will take the risk of flogging a dead horse.

Cases in which this treatment is adopted fall into two classes, one is that of slight crowding in the lower incisor and canine region, usually a Class I or mild Class II case (Fig. 1). The loss of the premolars is considered to provide too much room and in Class II cases would accentuate the recessive appearance of the lower jaw.

The other class is that where an upper incisor has been lost and it is considered wise to reduce the size of the lower jaw, so that the upper teeth may come together and close the gap (Figs. 9, 10).

The treatment in the first class is, I submit, based on the misapprehension that the remaining teeth in the lower jaw will slide round the alveolar ridge like beads on a wire, the bony arch remaining otherwise the same as before extraction, and this actually does seem to happen as far as the immediately adjacent incisors are concerned, the gap often being perfectly closed in a very short time. Unfortunately the extraction seems to be like the removal of the keystone of an arch, and in the course of time the two halves of the lower alveolar ridge collapse on each other with a resultant narrowing which is maximal in the inter-canine diameter. The canines in addition tend to slope mesially and the medio-

* *Transactions* of British Society for the Study of Orthodontics, 1933.

distal rotation, which is so common in cases of crowding, persists or is accentuated.

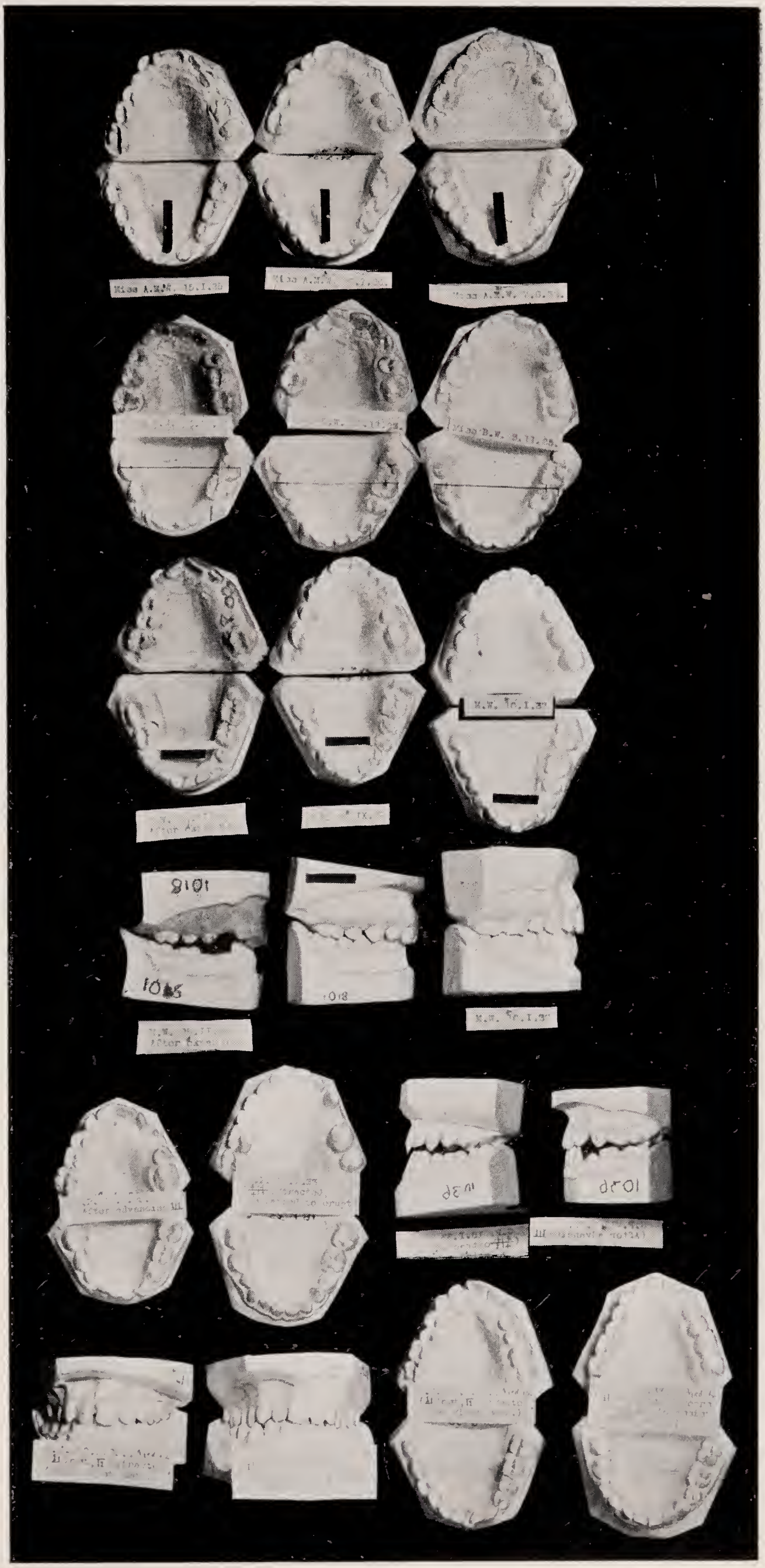
In the case of extraction to allow a gap in the upper incisor region to close, this collapse of the lower arch is just what is wanted, and the result is generally excellent, provided that such a collapse is not unsightly in itself.

The logical outcome of this line of reasoning would seem to be the insertion of a retainer immediately after the extraction if the collapse of the arch is not desired. The difficulty is that the collapse is gradual over a long period. In the case on the screen (Fig. 1) the collapse was not more than half completed by the end of the first year, and progressed slowly for six years after that. (There is also a shortening of the molar-incisor distance greater than the difference between the width of the temporary molar and permanent premolar. Molar .48 cm., premolar .35 cm.) The intermolar diameter is also very slightly reduced, but this is a very common occurrence in the lower jaw and no significance can be attached to it.

I would particularly draw your attention to the final shape of the arches; they are definitely V-shaped. This loss of the prominence of the canine region is generally conceded to be a disfigurement, and it was so in this particular case, though the general result was considered satisfactory. This V-shaped arch is in marked contrast to that produced in most cases of extraction of $\underline{4 \mid 4}$ (Fig. 3, compare Fig 1). It is interesting to notice the method of collapse of the lower arch. In each case there is a reduction in the molar-incisor interval and a narrowing of the inter-molar width, but in the case of Miss B. W. (see Fig. 3) the intercanine width is practically unaltered. The propping apart of the lower canines by the four incisors maintains the line of the upper incisors and canine, as can be seen.

The next case (Fig. 5) also ranks as a success. This case was originally treated by expansion, but the expansion was not maintained, and it was decided to allow it to collapse and treat by extracting $\underline{4 \mid 4}$. This was done in 1924. Two years later the condition was as shown, the arch was back to its original width (not shown here) but a lower incisor was squeezed out of alignment and was keeping the $\underline{1 \mid 1}$ forward also. It was therefore extracted in 1930, and three years later the other $\overline{1 \mid}$ was found to be similarly squeezed forward, with considerable loss of intercanine width. However, the usual backward collapse of the lower incisors (.25 cm. molar-incisor distance) has allowed the upper centrals to fall back, so that the appearance on the whole is improved (Fig. 6). This case also shows a slight intermolar narrowing since loss of $\overline{1 \mid}$ (Fig. 5).

Lastly, here are two cases of extraction with the deliberate intention of reducing the size of the lower arch. The first case (Figs. 7, 8) is Class III, where the upper incisors had been pushed over the lowers by means of screws. The resulting proclination of the upper incisors was rather unsightly, and there was imbrication of the lower incisors which would probably not have corrected itself even if $\overline{4 \mid 4}$ were extracted. It was decided therefore to extract $\overline{4 \mid 1}$. The incisors and canines have taken on a lingual



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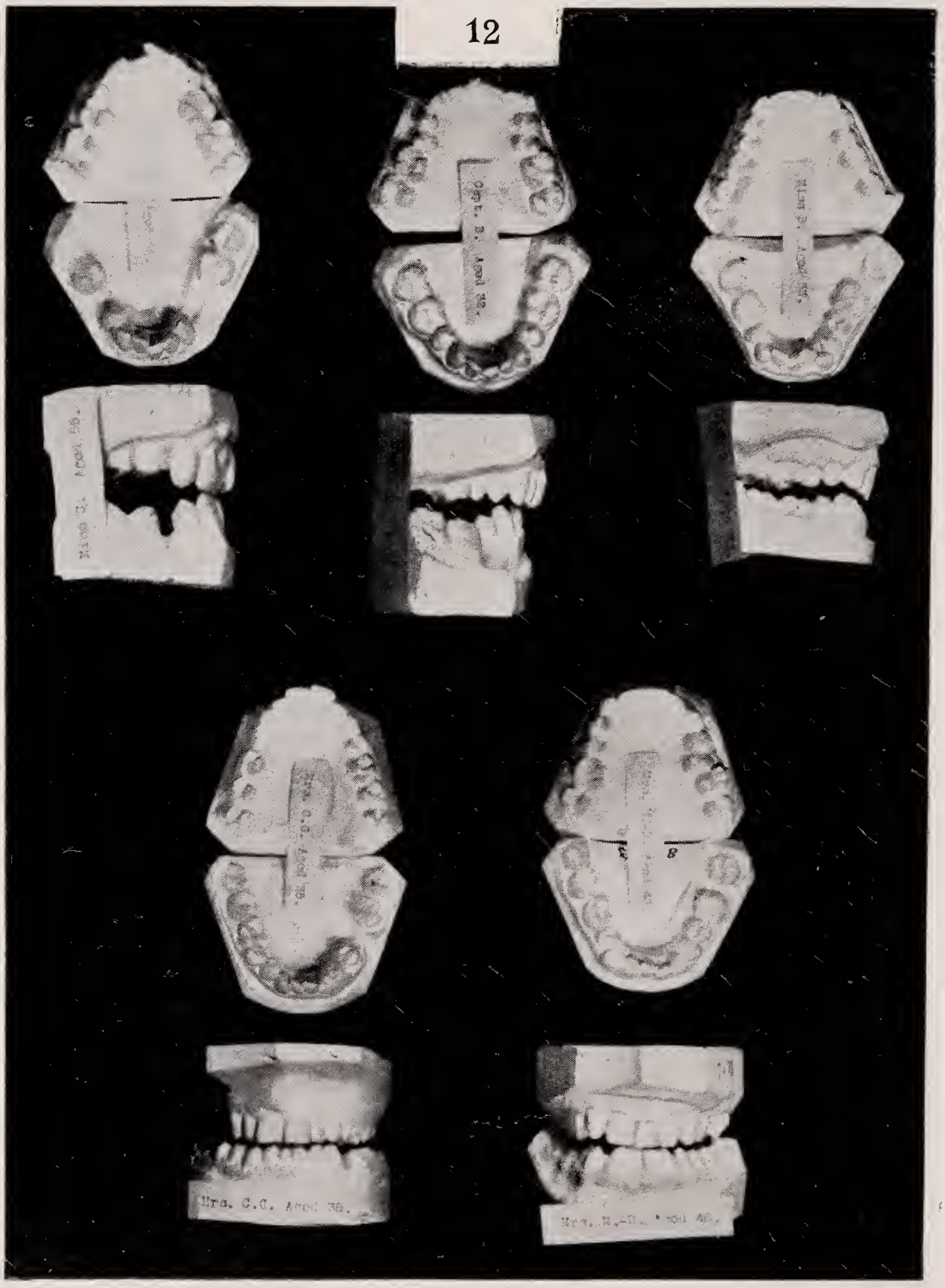
inclination, but the twisted lateral has righted itself without help, and as the lower arch has not collapsed any further in the last three years, I hope that there will be no overlapping of the remaining incisors.

In the last case an upper central was broken and extracted in November, 1927, when the boy was 11 years old (Figs. 9, 10). A lower incisor was extracted by the school dentist simultaneously to compensate for this, and the gap in the upper jaw slowly closed until it was about 3 mm. wide, when it remained stationary—the three lower incisors meantime had become badly imbricated. Finally a second lower incisor was extracted three years later in September, 1930, with the result that in the ensuing eighteen months the gap practically closed. At the boy's last visit the gap had quite closed and there was so far no overlapping of the remaining incisors—that remains to be seen!



In this case, as in the others, there is considerable narrowing of both arches anteriorly, maximal across the intercanine diameter, affecting all the posterior teeth to a steadily diminishing extent. Actually the intercanine collapse is almost the same as the width of the gap in each jaw. There is also a small (1 mm.) backward displacement of the incisors.

Now I will show you some late results of this form of treatment (Figs. 11 to 15). I cannot say what the original condition was, and the patients can only tell me that they had teeth extracted because there were too many. You will notice the backward inclination of the incisors, the mesial inclination of the canines and their mesio-distal rotation, but most particularly the marked crowding of the remaining incisors and the V-shaped arch. In two cases two incisors have been extracted. [N.B.—The upper jaw looks best in two cases where upper incisors have also been lost.]

Fig. 11. Models separated to show lower incisors, which would otherwise be concealed owing to close bite. Fig. 12. Ditto. Backward slope of incisors best shown in lateral models. Fig. 13. Ditto, well shown. Fig. 14. Rotation of canines. $\frac{1}{1}$ gone. Fig. 15. Ditto.

From the foregoing cases it would appear to be fair to conclude that if the collapse of the lower arch both laterally and antero-posteriorly is not going to matter in any particular case, and if the resulting contraction of the incisor region of the upper jaw is also no disadvantage, then this method of treatment is legitimate and may be the best.

The next group of cases to which I want to draw your attention is Angle's Class II, Div. 1, treated by extraction of $\frac{4}{4}$, allowing $\frac{3}{3}$ to fall back, and retracting incisors. Figs. 16, 17 represent a typical case—pseudo-normal owing to premature extraction of lower milk molars. It is of course a commonplace that if a retainer is not worn the second premolar and first molar will drift forward until the spaces are obliterated, and the patient will be no better off than before in appearance, and worse in function. It is, however, considered good practice to extract the $\frac{4}{4}$ and insert a plate or arch to retract the incisors, and it is generally understood that in this case the molar and premolar together will give adequate anchorage and will not move forward much during the time required for the incisor retraction. I have more than once been disappointed by the small improvement produced by a quite considerable retraction of incisors, and decided to measure a few cases so treated.

In arriving at the movement of the incisors and molars relative to the arches as a whole, I found it unsafe to choose any teeth in either jaw as fixed points, and was driven to the expedient of selecting a characteristic point in the rugæ—usually the first or second pair of lateral ridges or the small papillæ between them. Anything further forward than this was liable to be compressed antero-posteriorly by the movement of the incisors (Fig. 17). This convention may be unsound and the whole of my measurements may be invalidated, but I know of no other available method.

The first few cases were taken from the records of the practice in which I am a partner. These were all treated by fixed appliances consisting of an upper arch sliding in tubes on molar bands, with

cleats hooking under the morsal edges of the incisors to prevent tilting upward of the arch and consequent rocking forward of the anchor teeth. The only movement of the molars and premolars allowed by this appliance is a bodily translation forward of the roots through the bone. Traction was exerted by elastic bands. Here are a few cases so treated.

Case I.—Treatment was commenced by extraction of $\frac{4 \mid 4}{}$ (Fig. 18), the arch was inserted immediately, and the gaps between the erupting canines and the erupting second premolars reduced from 8 mm. to 2 mm. in a year. The projecting centrals were brought back further until they were in good position. Actually what happened was the forward movement of the $\frac{6 \mid 6}{}$ by 3 mm. and a backward movement of the incisors by the same amount, so that

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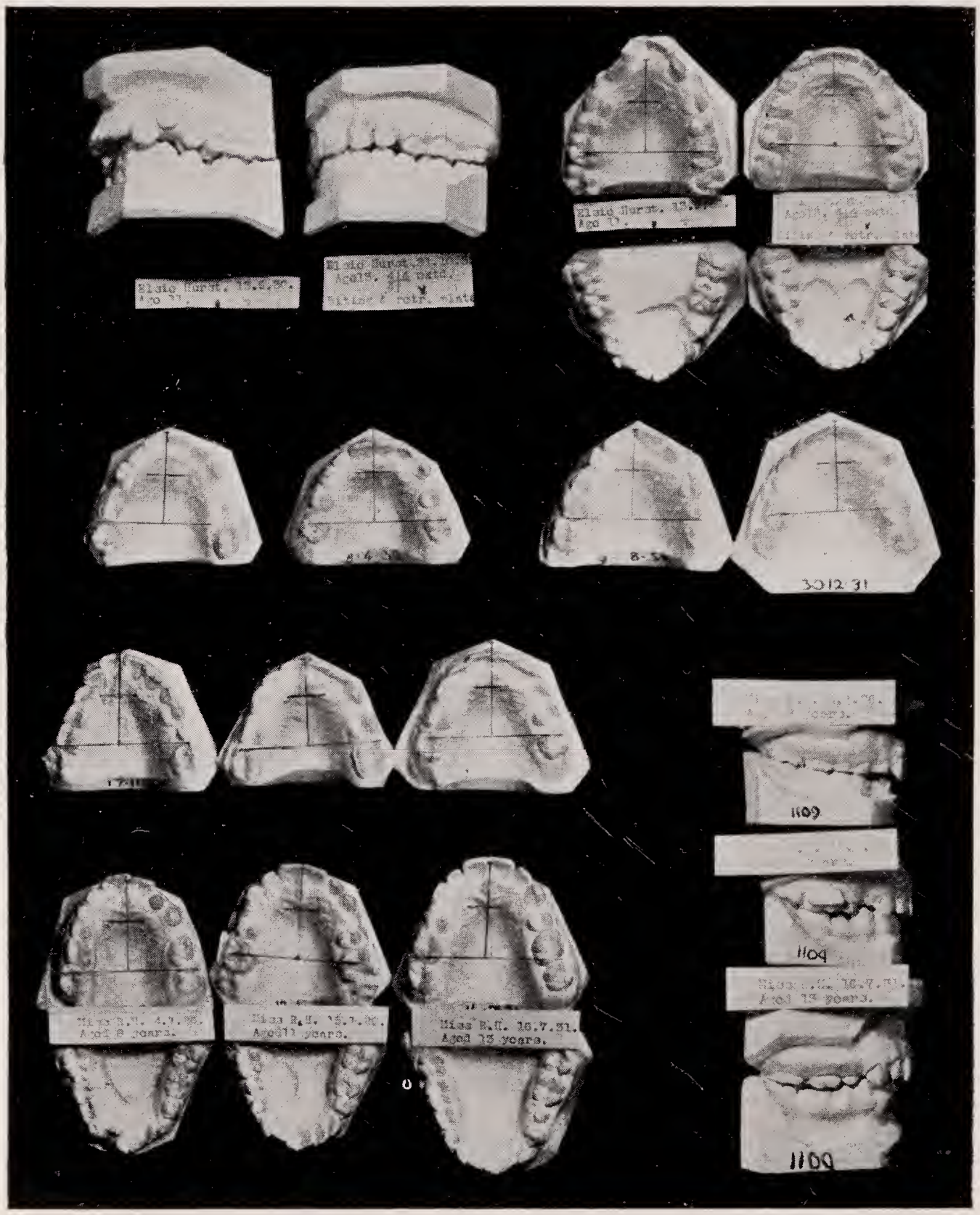

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the overjet of the upper incisors was only corrected by half. The method of measurement was to rule lines on a piece of celluloid (see Fig. 18). The short transverse line was applied over a fixed point on the rugæ and the sagittal line made to correspond with the median raphe. Actually the short transverse bisected the other line, but that is not an essential point. For photographic purposes I made two or three identical celluloid scales so that I could photograph them simultaneously.

Case II.—The next pair of models shows the same thing (Fig. 19). The molar-incisor interval was here lessened by 9 mm.—nearly a centimetre—the forward movement of molars and premolars accounting for $4\frac{1}{2}$ mm.

Case III.—The next case (Fig. 20) is interesting in that the first appliance was a removable biting plate with retraction arch attached. Nearly 5 mm. reduction of the molar-incisor distance was obtained, and again about half was due to the forward movement of the molars. A fixed appliance was then used and a further 3 mm. reduction obtained, again half at the expense of molar movement. This case prompted me to investigate a number of hospital cases treated by plates. The results of some of these I will show later.

Case IV.—Figs. 21, 22. This is a Class II case where an attempt was first of all made to treat by expanding the jaws, followed by raising and jumping the bite. This method proved unsatisfactory, and the $\underline{4 \mid 4}$ were extracted and a fixed retraction arch fitted. Seven months later the $\overline{\mid 1}$ was extracted. In the series of models shown I have selected the earliest pair showing the untreated case; then, omitting the period of expansion, a pair after the arches had been allowed to collapse, and the $\underline{4 \mid 4}$ had been extracted for eight months; finally again showing the finished case two and a half years after the loss of $\overline{\mid 1}$.

A comparison of the first two pairs shows that the expansion had collapsed completely—the intermolar diameters are exactly the same. The lower incisors are much improved in alignment, but as the intercanine measurement of the permanent canines is actually slightly less than that of the deciduous canines, it would be rash to say that the improvement in the incisors could not have come about naturally. I mention this point here because it has a bearing on what I shall say in connection with another group of cases. The incisor-molar distance has been reduced 2 mm., but although retraction had been in progress for six months, there is no measurable reduction in the distance between the central incisors and a given point on the palate, and the molars have come forward practically 2 mm. in relation to the same fixed point.

Now comparing the last pair of models with the earlier ones, the intermolar width is slightly reduced—0.5 mm. upper and 0.9 mm. lower, and the interpremolar $\underline{(5 \mid 5)}$ width nearly 2 mm. (1.9) in $\underline{4 \mid 4}$ both jaws. The intercanine diameter in the upper jaw is only reduced by $\frac{1}{3}$ mm., though the corresponding reduction in the lower jaw consequent on the loss of $\overline{\mid 1}$ is 3 mm. The only reason

I can find for this is the fact that the upper canines are now in contact with and kept out by the buccal surfaces of the $\overline{4 \mid 4}$, whereas in 1929 they were anterior to them and in contact with the $\overline{3 \mid 3}$. Further retraction has reduced the incisor-molar interval by $2\frac{1}{2}$ mm., of which the incisor movement accounts for another $\frac{1}{2}$ mm. and the molar movement for the remainder.

The net result of treatment therefore is that the incisors have been brought back by about $\frac{1}{2}$ mm. and the molars forward by about $4\frac{1}{2}$ mm. The irregularity of the lower incisor has been made inconspicuous and the arches as a whole have been slightly narrowed, especially anteriorly. The incisor overjet has been reduced just over 1 mm., so the appearance is distinctly improved—this may perhaps be put down to the credit of the lower appliance for advancing the incisors.

I have analysed this case rather fully as it throws light on the effect of the extraction of a lower incisor as well as of upper premolars and retraction of incisors, and incidentally it illustrates a point to which I wish to refer, the complete collapse in some cases of expansion undertaken as early as 7 to 8 years of age.

Now here are a few cases treated at the Royal Dental Hospital by extraction of premolars and retraction of the incisors by removable appliances. These consist in every case of a vulcanite plate covering the palate except just behind the incisors, and a wire arch attached to the molar cribs, with W bends to provide the necessary spring. Where necessary the canines are retracted first by fitting them with bands and hooks and retracting them with elastic bands attached to hooks on the cribs of the plate.

Elsie Hurst, Figs. 16, 17. In this case $\underset{4 \mid}{\underline{4 \mid 4}}$ were extracted and $\overline{\mid 4}$ left, and I should like you to notice that the $\overline{\mid 5}$ has found room to erupt. No expansion was carried out, but the $\underline{3 \mid 3}$ were retracted first and the bite raised. The incisors were then retracted by another plate. The slide shows how the molars have moved forward to about the same extent as the $\underline{1 \mid 1}$ have moved back, in spite of the retaining effect of a plate fitting over the palate combined with cribs on the molars.

G. Goddard, Figs. 27, 28. This case is almost exactly similar, but here some expansion was necessary to make room to retract the $\underline{1 \mid 1}$. Then $\underset{4 \mid 4}{\underline{4 \mid 4}}$ were extracted and the case completed by retraction of $\underline{3 \mid 3}$ and later $\underline{1 \mid 1}$. Here again the molars have moved as much forward as the incisors have back.

Other cases are similar. I will show only one more. This boy (John Hill, Figs. 29, 30, 35, 36) had an open bite and a history of thumbsucking. My decision to extract $\underset{4 \mid 4}{\underline{4 \mid 4}}$ was due to the hope that the incisors would pivot downwards and backwards about their apices, thereby reducing the open bite. This did occur, but at the moment I only want to show that the molars have moved forward as much as the incisors have back. The incisors were retracted as part of the process of straightening them, and closing the gaps caused by the loss of the premolars.

Fig. 30 shows not only the reduction in the incisor-molar interval, due presumably to the roughly equal movement of molars and incisors since the molar occlusion remained normal throughout, but also the maintenance of the intercanine width as contrasted with the probable result of extracting an incisor. The intermolar diameter is very slightly diminished.

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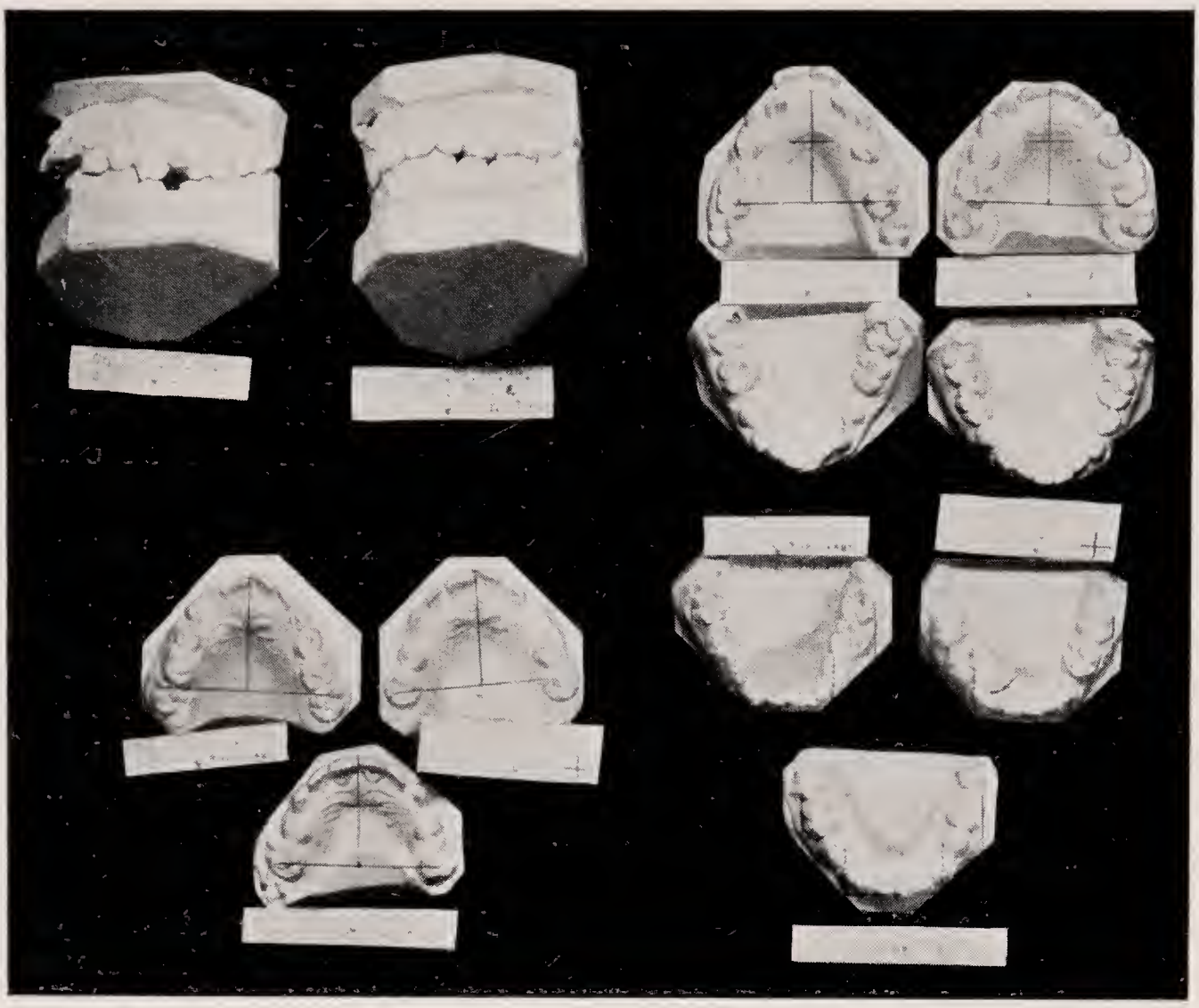

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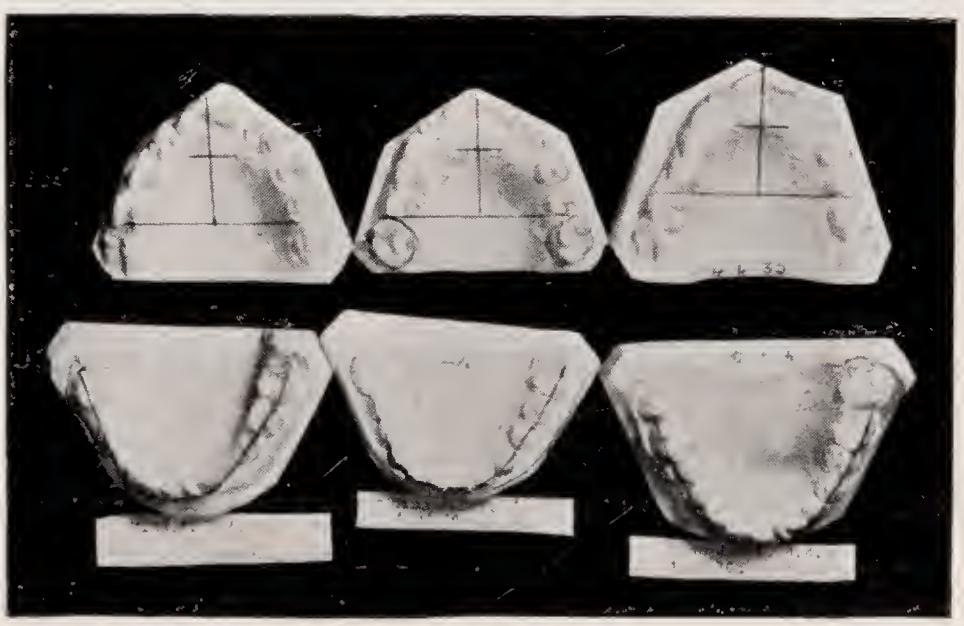

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This brings me to another question—namely, that of the natural growth of the arches. I have found in measuring models that a slight reduction in the various diameters is almost the rule following treatment by extraction, the position of maximum reduction varying with the tooth or teeth lost, but I have also found that quite commonly, especially in the lower jaw, there is a slight loss of width in cases that have received no treatment or have been treated by expansion without extraction. You have seen one or two cases treated by extraction where width has been lost; now here is one (Fig. 31) which was treated by expansion of both arches, combined with advancement of all the incisors.

As you can see from the position of the black line, there has been a relapse, complete in the lower jaw and practically complete in the upper, in the course of six years. The twisted lower incisors and the imbricated upper centrals are as bad as ever, and there has been a definite reduction in the width of both arches, and you will notice that the upper molars have come forward long after the replacement of milk molars by premolars, although no teeth have been extracted. It is not difficult to multiply such cases, although I have shown only one example.

Now the obvious retort to this jeremiad is that it is a matter of common experience that many cases of crowding treated by expansion, especially if commenced at an early age, do very well indeed and are permanently rectified. I am not prepared to deny the truth of this, but I would at least suggest that *post hoc ergo propter hoc* is a fallacy that may obtain in orthodontics as well as in other spheres. The growth might have occurred in any case. May I as a final point elaborate this by showing a few assorted cases.

Fig. 32. Here is a case of unilateral lingual incisor occlusion with insufficient space in the premolar region on both sides. The lingual incisor occlusion was dealt with by means of a plate with screws bearing on the left upper central and lateral. It was intended to treat the crowding later on by extracting premolars. You can see from the mirror reflections that these premolars are still there and there is no longer any crowding.

The occlusal view (Fig. 33) shows this more clearly. Now on the left side the pushing forward of the incisors has allowed the canine and a first premolar to come forward and so released the impacted $\underline{|\,5}$ so that treatment has cured the condition. On the right, however, there has been no treatment except the presence of a plate which would tend to splint the teeth in place. Here, however, the crowding was at least as great, and yet it has cured itself; the space between lateral and premolar is obviously greater. Fig. 34 seems to show that it is due to growth in the incisor region since the molars have remained stationary.

I showed a case earlier (John Hill, Figs. 29, 30, 35, 36) of open bite treated by extraction of $\frac{\underline{4\,|\,4}}{4\,|\,4}$ with an excellent result. I should have put this to the credit of the extractions but for the fact that the boy did not come for treatment for over a year after the first visit, and in the interval the open bite had almost closed without treatment.

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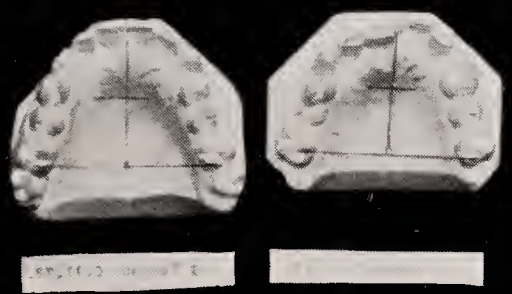

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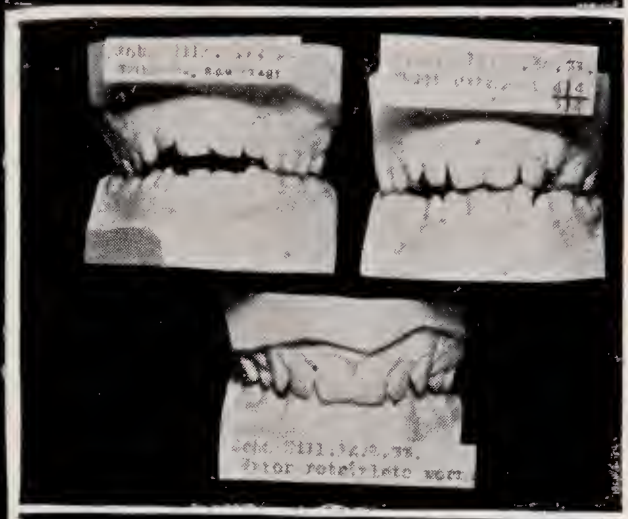

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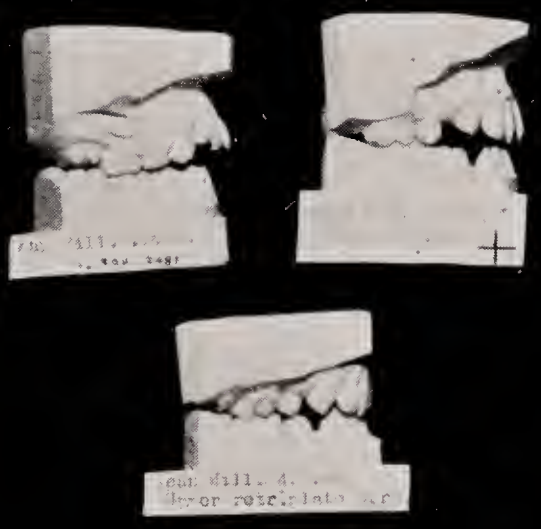

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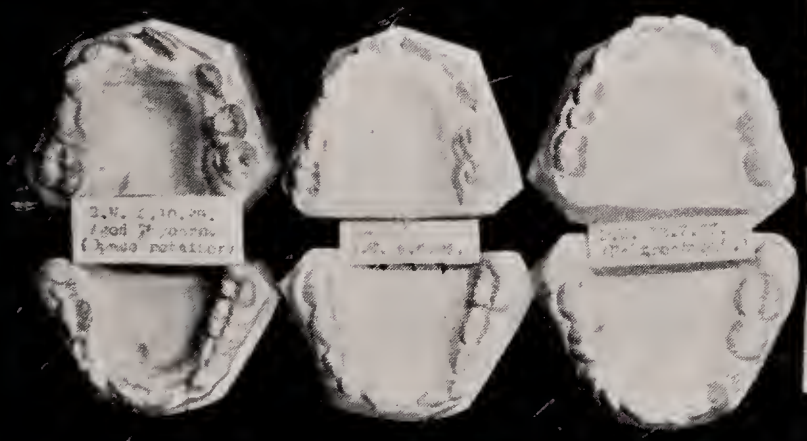

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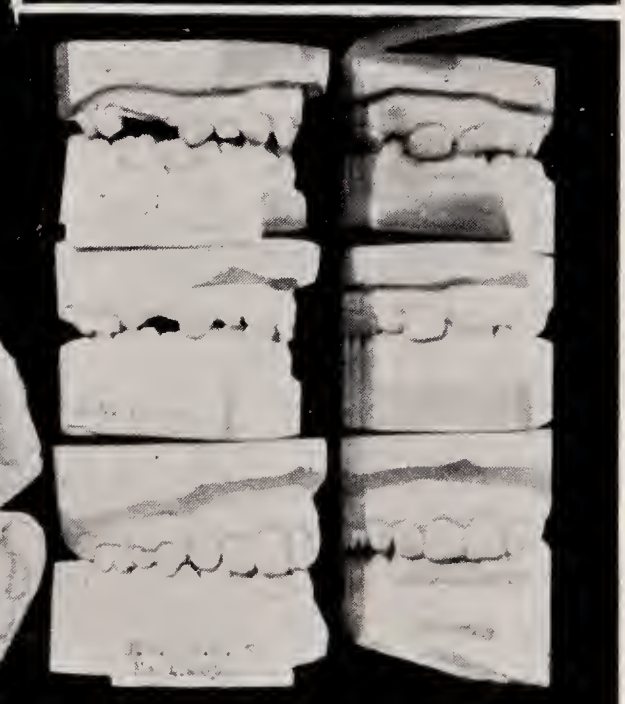

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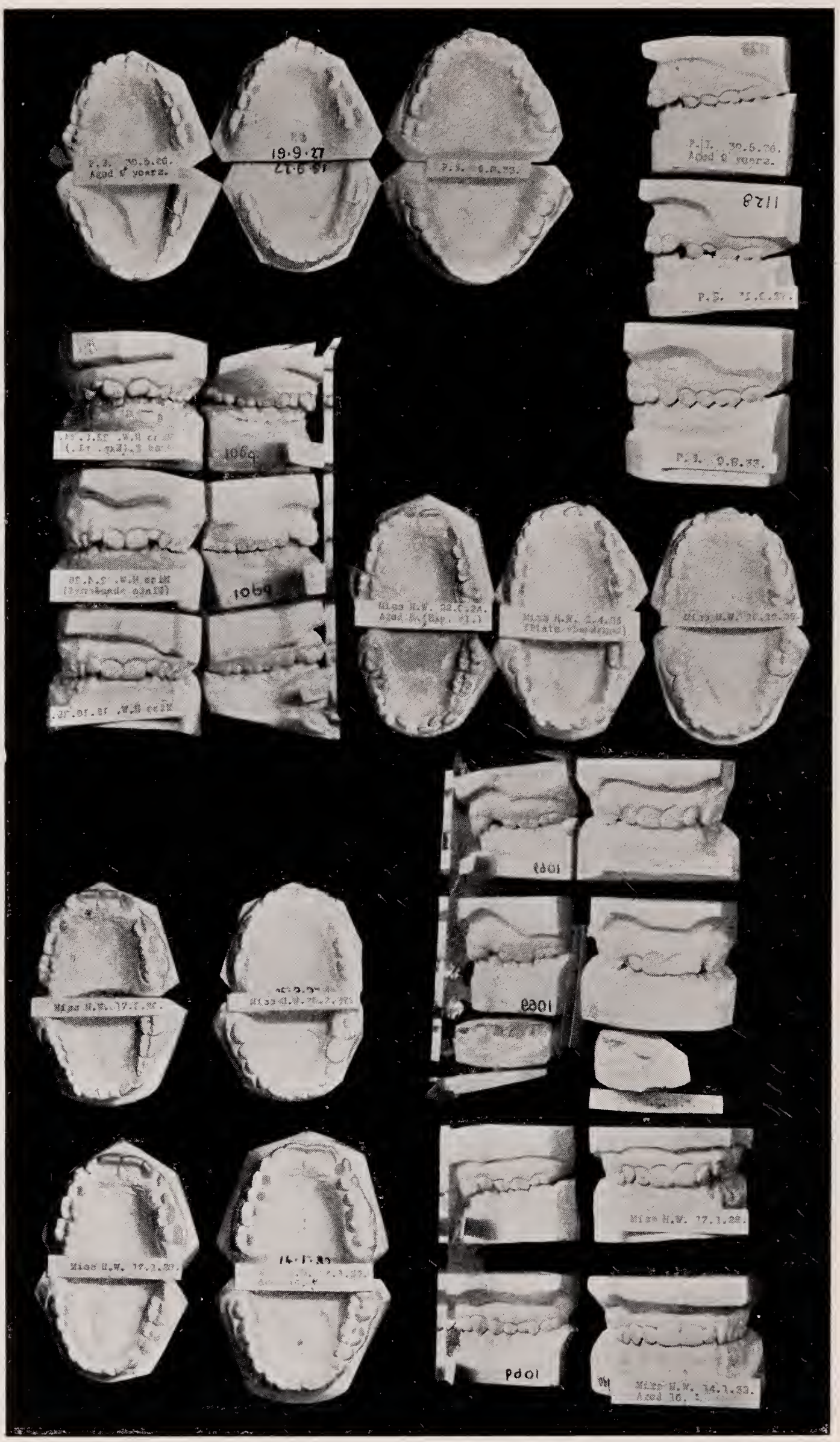

Fig. 37. Here is a boy whose parents were worried because the lower incisors appeared crowded. I advised waiting and took models and measurements. In three and a half years the teeth had straightened themselves and the various measurements were considerably increased in both directions.

Intercanine	Upper	3.50—3.81	Increase	0.31 cm.
,,	Lower	2.83—3.03	,,	0.2 ,,
First Milk Molars	Upper	4.27—4.52	,,	0.25 ,,
,, ,, ,,	Lower	3.67—3.67	,,	— ,,
Second ,, ,,	Upper	4.85—5.12	,,	0.27 ,,
,, ,, ,,	Lower	4.53—4.71	,,	0.18 ,,
Perm. Molars	Upper	5.45—5.71	,,	0.26 ,,
,, ,,	Lower	5.18—5.48	,,	0.3 ,,

If I had expanded at the age of $6\frac{1}{2}$ or 7 the expansion would have been permanent, of course, and I should have had all the credit.

The next case (Figs. 38, 39) is one showing unsightly irregularity of the incisors and apparently insufficient space in the upper premolar region. The only treatment was the wearing of a space retainer for a few months following the extraction of a septic milk molar. The plate was abandoned directly the second premolar began to appear and while there was still a gap in front of it.

This case threatened to be post-normal also. The second deciduous lower molars are not yet lost, but it is obvious that it will end as a case of normal occlusion with very little incisor irregularity, and that is hereditary in this case.

Fig. 40. Here is a case of threatened Class II, Div. 1, with the lower incisors biting against the gingival margin of the upper incisors. I warned the parents that I should probably have to raise the bite, but the boy left the country for a year, and on his next visit had so much improved that I decided to wait. I have not shown measurements on the models, but the intermolar diameter increased in the upper jaw $1\frac{1}{2}$ mm. and in the lower 1 mm. between 1926 and 1933. Fig. 41 shows how the occlusion finally righted itself. This boy had a narrow escape from being an orthodontic success.

Lastly I will show a similar but even more striking case (Figs. 42 to 46). The first slide (Fig. 42) shows a threatened Class II case with overlapping of the incisors in both jaws. This, by the way, is the sister of the case before last, so that the position of the $\underline{1}|$ is hereditary. An expansion plate was worn for a short time and then abandoned, and the width gained relapsed completely. The successive models show the gradual decrease in crowding, though the occlusion remains the same. By the end of 1925 the case appears to be definitely a Class II, Div. 2, with the typical proclination of laterals and retroclination of centrals. As the child was a relation of mine I was able to take models when I liked. I took fourteen pairs in all. These are a few of the more representative of them. The incisors are gradually straightening themselves until the arches are practically perfect, except for $|\overline{1}$ (Fig. 44). This also is an hereditary abnormality. The occlusion up to the age of $11\frac{1}{2}$ is still post-normal, and a squeeze bite taken in 1927 confirms that the models are correctly articulated (Fig. 45).

Now if you will compare the last two models (Fig. 46) closely you will see that the occlusion has become definitely Class I, between 1928 and 1932. In the first the relation of the canines is definitely post-normal, in the second the position is reversed.

Mr. President, I am afraid I have no conclusions to draw from these cases, unless it be the rather depressing one that among cases treated early, the successful ones are those where bone growth was destined to occur, and the unsuccessful ones where for some reason there is little or no bone growth. I must admit that I grow very tired of hearing orthodontists speak confidently of "stimulating bone growth by the insertion of an appliance," when, so far as I am aware, there is no scientific or experimental justification for such an assumption. Also, I believe that an orthodontist is essentially an opportunist and should not allow himself to be trapped into treating cases according to an imperfect classification; but I have presented these cases mainly in the hope of hearing what conclusions will be drawn from them by those of greater experience than myself.

(The author regrets the vagueness of some of the illustrations reproduced from the slides, unavoidably the same size; the slides showed clear enough on the screen).

Discussion.

Mr. Harold Chapman said the only complaint he had to make about the paper was that Mr. Ainsworth had given so much in it that it was difficult to deal with all the points he had raised. Needless to say, the cases showing the loss of incisors were deeply interesting to him, but he was not sure that Mr. Ainsworth was happy with some of the results. (Mr. Ainsworth: "Very few.") He was not at all convinced that the loss of an incisor was any good in any one of the cases, though he had not had an opportunity of studying them very carefully. But he thought he was led to say that incisors should not be removed, and he was glad the lecturer had found cases which, years after completion of treatment, went to emphasise that point. Although his own experience of this treatment was small, the result was similar.

The next series of cases dealt with the loss of first upper premolars and subsequent retraction of the upper incisors. The impression he had was that it had been argued in the Society that the incisors could be brought back without the upper premolars and molars moving forward when the latter were used for anchorage. He was glad Mr. Ainsworth had done what he (the speaker) had hesitated to do. Mr. Chapman illustrated, by means of a diagram on the blackboard, that if the lower arch is one cusp post-normal and it is desired to retract the upper anterior teeth into correct relations with the lower anterior teeth, the upper posterior teeth must not be used as anchorage for that purpose because they would inevitably move forward and preclude the possibility of putting $\frac{3}{3}$ in the position of $\frac{4}{4}$, an essential for successful treatment: the lower arch, by means of intermaxillary traction, must be used for anchorage. However, if the post-normality is less than one cusp, the upper cheek teeth may be used for anchorage so long as they do not move further forward than corresponds to post-normality of the lower to the upper arch of one cusp: if, when this occlusal relationship is reached, further retraction is necessary, intermaxillary traction must be used for the purpose. These considerations apply when it is necessary to bring about normal relations of upper and lower incisors: for teaching purposes to view the problem in the manner described is very helpful. The use of celluloid sheets to show changes of position

of teeth in relation to other teeth was extremely helpful. He thought they were all very deeply indebted to him for bringing to them cases which had obviously been watched in one practice for a large number of years. Such cases were extremely hard to get, and for that reason he felt that the members very greatly appreciated what he had done that evening.

Mr. NORTHCROFT said he would like to congratulate Mr. Ainsworth on the presentation of these various cases. Incidentally he wished to endorse every word that Mr. Chapman had said ; he deprecated the bringing back of incisors against the anchorage of the 6 and 5. In his experience the 6 and 5 very frequently moved forward, and he thought Mr. Ainsworth had shown pretty clearly that it was about fifty-fifty, and they were bound to get that forward movement unless inter-maxillary traction is used.

Mr. MAXWELL STEPHENS said it just occurred to him to ask regarding the question of the open bite whether Mr. Ainsworth had got any record of the giving-up of the habit of pressure of the lips by thumbsucking and its effect on the incisors. He thought that what Mr. Northcroft suggested in regard to the last case was reasonable.

The PRESIDENT thanked Mr. Ainsworth on behalf of the Society for bringing forward his valuable paper and for his contribution of ideas. He would like to ask for something a little more definite about the celluloid strip, for he felt there might be some error of parallax in placing the mark. He thought Mr. Chapman had agreed with what he said in his Presidential address as to the extraction of a lateral, but it had been found to be a good expedient at times and the result was quite pleasing. He had a very intelligent nurse who had been a mechanic in a workshop. One of her friends had a lateral extracted, and she knew that friend two years before she discovered that she had lost a lateral. What strength of wire did Mr. Ainsworth use for moving forward the molars, and was he definitely sure every time the patient made a visit that there was an upward spring on the hooks ? The upward spring must be maintained so that the reaction tended to tilt the molars backwards. He suggested that if the ends of the bow wire were snipped off with cutters and left rough this would often stop movement, but if the ends were ground off with a stone, making them smooth so as to slide freely, in the buccal tubes, the case would go along nicely.

Mr. AINSWORTH, in reply, thanked the members for their kind reception of his paper. There was little for him to reply to as there had been unexpectedly little opposition. With regard to the extraction of lower incisors, Mr. Chapman had spoken of poor results, and he agreed that so far as the effect of the loss of the incisor was concerned, they were poor results, though one or two of the ultimate results from the point of view of general appearance were satisfactory. As regards the retraction of upper incisors, Mr. Chapman agreed with the effect on the upper molars, that one did get the loss of available space ; his exposition on the blackboard was valuable and gave a logical basis for selecting the procedure to be adopted. Mr. Northcroft had referred to the last two cases of spontaneous change from Class II to Class I, and his explanation, based on the opening of the bite by the second molars, was illuminating : he would keep his eyes open for further cases. Mr. Maxwell Stephens had asked if the case of open bite treated at hospital gave a history of thumbsucking, and whether the habit was broken. He had no data on the last point, but there was a history of thumbsucking and he was prepared to concede a lot to that fact.

The President had spoken of the possibility of error in using celluloid sheets. There was the possibility. It was difficult to photograph two models together with celluloid superimposed in exactly the same way in each. He had photographed the models inside a tea chest, the floor

was blackened, a door made at one side, and the camera pointed down through an aperture in the lid. To adjust the celluloid sheets, the model was placed beneath the hole, and moved about so that the selected points on it passed in turn vertically underneath the centre of the hole, the corresponding lines on the celluloid were then made to coincide by adjusting the position of the celluloid accordingly. When the models to be compared were thus adjusted they were placed side by side and tilted so that the surface of the celluloid was roughly at right angles to the line joining it to the camera lens, thus avoiding distortion. The President had referred to the loss of an upper lateral in one case ; it was the central that had been lost and the lower central was extracted on that account. It was precisely those cases which showed good results on extracting lower incisors ; where a lower incisor had been extracted and not an upper as well, the result was not so good. The retraction arch was given an upward spring as the President had said. In the case described at length there was a record that the arch had had to be abandoned for some time because the upper incisors had been shortened to a considerable extent, and that was fairly good proof that the arch was exerting upward pressure ; forward movement of the molars occurred nevertheless.

INVESTIGATION INTO THE NATURE OF "CLOSE BITE."*

PART I.

By Dr. S. Friel and Mr. H. T. McKeag.

Object of Investigation.—To discover whether it is possible to determine by measurement on living subjects any association between under- or over-development of any area or areas of bone in the face and the dental condition known as "close bite."

Selection of Material.—The first necessity was to determine exactly what constitutes the condition well recognised by dental surgeons under the term "close bite," but nowhere defined authoritatively. While in the last resort the criterion of normality or abnormality must be that of function, it was necessary if possible to use a mathematical standard, in order to eliminate the factor of individual judgment. Preliminary investigation showed that if the standard were fixed so that where the left upper central incisor overlapped one-half of the lower left central incisor or more, the condition was regarded as abnormal and classed as "close bite," then the division so created coincided fairly well with a division made on functional grounds. The material was accordingly divided into two classes on this basis :—

(*a*) Characterised by normal incisor bite with normal occlusion elsewhere.

(*b*) Characterised by "close bite" with any form of occlusion elsewhere.

Each of these classes was divided into age groups.

Material.—The human material on which the investigation was made belonged to the Artane Industrial School, near Dublin, and consisted entirely of boys. The boys are either orphans or have been removed from undesirable homes, and come from all parts of the Irish Free State, though the majority belong to the Dublin district. Thus, though divided as between town and country origin, they represent generally one social stratum. The minimum age of admission to the school is eight years, but many are admitted later. Consequently the age groups were small at the earlier ages. Again, the standard leaving age is sixteen years, but boys may go earlier, so that the age fifteen is not so well represented as the middle ages.

The total number of boys at the school averages 800 to 900, but it was necessary to reject those in whom the result of extraction of teeth might have vitiated the measurements or classification, as well as those who did not fall into either of the two classes under examination. Hence the total number whose measurements were used was about 400.

Methods and Instruments Employed.—In the absence of any real hypothesis as to the areas of bone involved in close bite it was obviously desirable to obtain measurements of all areas, under- or over-development of which might possibly be associated with "close bite"; and it appeared that there was no area included in the masticatory face which could reasonably be excluded from the examination. Accordingly a series of measurements was worked out which it was thought would cover all dimensions of the bones sufficiently defined to be recognised and uniformly located.

* The authors wish to express their gratitude to the Medical Research Council for the grant which enabled this investigation to be carried out.

As the basic point from which to measure radially the central axis of the cartilaginous external auditory meatus was alone available; while for the basic plane for vertical measurements the nearest approximation to the Frankfurt "horizontal" plane which could be obtained in the living subject, was chosen. The actual plane was that passing through the central axis of the cartilaginous external auditory meatus and the lowest point of the lower border of the left orbit. In order to obtain a record of dimensions from both these bases to points on the centre line of the face, an instrument was devised of which the framework could be immobilised in relation to the head, on which it was supported, while a slideable pointer, rotating about plugs in the external auditory meatuses, could be applied in turn to each point in the centre line of the face. The movements of this pointer controlled the movements of an indicator applied to a chart, which could be fixed so that its zero-line remained parallel to the "horizontal" plane. Thus marks made on the chart in accordance with the various positions of the indicator, bore the same relationship to one another and to the "horizontal" plane as did the corresponding positions of the pointer. The centre line group thus recorded were :—

Nasion.
Sub-nasal point.
Upper incisor gum margin.
Upper incisor incisal edge.
Lower incisor gum margin.
Mental point.

In order to record the relative position of the gonion, or some uniformly recognisable point as near it as possible, an instrument was devised which measured the distance from two points registered by the previously described instrument, to the point of intersection of lines running along the hinder border of the ascending ramus and the lower border of the horizontal ramus. These distances being known, the position of the gonion could be fixed on the chart.

Other measurements taken, with the instruments used, were :—

Nasion to sub-nasal point
Nasion to upper incisor incisal edge
Nasion to sub-mental point
Nasion to medio-lingual cusps of $\underline{6 \mid 6}$
} Calipers devised by Campion, and used by Miss K. C. Smyth on L.C.C. school children.

Lower incisor incisal edge to submental point.

Morsal surface $\overline{6 \mid 6}$ to lower border of mandible, vertically.

Head, length and breadth
Zygomatic breadth
Gonial breadth
} Martin's Calipers.

Depth of palate from medio-lingual cusps at $\underline{6 \mid 6}$ to centre line of vault
Length of dental arch from distal surface of $\underline{6 \mid 6}$ to labial surface of $\underline{1 \mid 1}$ at incisal edge
Length of lower arch from distal surface of $\overline{6 \mid 6}$ to labial surface of $\overline{1 \mid 1}$ at incisal edge
} Instruments used by Miss K. C. Smyth on L.C.C. children.

Overlap of upper left central incisor over lower left central incisor.
Height of lower left central incisor crown.
Hand-grip, left and right
Molar bite, left and right
Incisor bite
Tongue pressure, vertical lip pressure and horizontal lip pressure
Jaw depressor pressure (teeth closed)
} Friel's dynamometers.

Arch breadths between buccal surfaces of

$$\frac{6 \mid 6}{6 \mid 6},\ \frac{4 \mid 4}{4 \mid 4} \text{ or } \frac{d \mid d.}{d \mid d.}$$

Impressions of the teeth (composition)

Results.—A statistical analysis of the figures obtained was made by Dr. Matthew Young, and in view of the detailed statement contained in his appended report only general consideration of the results is necessary here. Two facts require to be kept in mind in judging the value of these figures as evidence of correlation between close bite and any of the other characters recorded. First, that in order to have numbers sufficiently large to be statistically useful it was necessary to use the figures of two series of recordings made with an interval of a year, during which modifications were made to the most important instrument used, the prosopometer, which appeared to make a substantial improvement in the consistency of its records ; so that the two series are not of equal reliability. It is probable that any errors due to the inclusion of the earlier series would obscure actually existing correlations rather than create apparent correlation where none existed ; but this fact points to the use of caution in accepting the results as finally established. Secondly, as the investigation proceeded it was found that the grosser forms of " close bite " were comparatively rare, and that certain generally recognised types, notably that characterised by marked protrusion of the upper incisors, were entirely absent. From one point of view it might be argued that if correlations appear in the absence of gross examples, then with a more representative sample of material more marked correlations would be found. On the other hand the possibility must not be overlooked that any conclusions drawn from the present findings are applicable to certain forms of " close bite " only which happen to be represented at the Artane school.

The most interesting of the correlations shown between the amount of overbite and facial dimensions are :—

(*a*) A slight tendency for an increase in the dimensions Frankfurt plane to upper incisor gum margin, vertically, and to upper incisor incisal margin to be accompanied by an increase in the amount of overbite. The correspondence between the co-efficients of correlation for these two measurements points to an increase in bone dimensions rather than an elongation of the incisors as the important factor.

(*b*) A slight tendency for a decrease in the dimension Frankfurt plane to lower incisor gum margin, to be accompanied by an increase in the amount of overbite. There is also a slight negative association between the amount of overbite and the dimension Frankfurt plane to mental point, though it cannot be considered

statistically significant on the numbers available. The reduction in association between the amount of overbite and the F.P. to M.P. measurement as compared with that from F.P. to L.I.G.M., is explained by the positive association between the amount of overbite and the dimension lower incisor incisal edge to lower border of mandible vertically which is present but so slight that it cannot be considered significant. The amount of overbite is quite unrelated to the height of the crown of the lower incisor. Comparison of the average measurements of the dimension F.P. to L.I.G.M. in boys with "normal" overbite and "close bite" at corresponding ages, shows a definite decrease in the latter.

(*c*) A slight but significant tendency for the length of both upper and lower arches to decrease with increase of overbite, the degree of association with the latter being about twice that with the former. As regards the upper at any rate, there is some reason for thinking that the appearance of this decrease was connected with the prevailing form of "close bite" found at the school. In this connection it may be remarked that the only measurement of arch length which could be devised, distal surfaces of $\frac{6 \mid 6}{6 \mid 6}$ to labial surface of central incisors at incisal edge, is a measurement of the tooth arch only and is not necessarily an indication of alveolar arch length. Comparison of the average measurements of L.L.A. in boys with normal bite and boys with "close bite" at corresponding ages shows a definite reduction in the latter.

(*d*) A slight tendency for an increase in overbite to be accompanied by a decrease in arch width in premolar and molar regions in both upper and lower jaws.

None of these correlations was very marked except that between L.L.A. and "close bite," but all were sufficiently so to be "statistically significant."

It can probably be accepted as definitely established that there is no association between strength of molar or incisor bite and "close bite."

From clinical observation it appears likely that "close bite" is not one condition, but can be divided into at least three, probably of widely different characteristics apart from the excessive overlap of the incisors. An attempt was accordingly made to group the "close bite" cases examined on a basis of individual judgment. It was only found possible to isolate thus one group in sufficient numbers to make comparison with normal useful. Owing to the fact that this selection was made from models no useful indication can be given of the clinical type of this group. All its members had vertical or slightly retruding upper central incisors. This was sub-divided into two classes characterised by :—

(*a*) Normal molar occlusion.

(*b*) Posterior relationship of lower molars to upper.

It was thought that these sub-divisions formed possibly an originally homogeneous group in which the lower arch, during development, had adapted itself to the abnormal conditions due to the "close bite" in different ways, but Dr. Young's analysis shows some "significant" differences between them. It is to be observed however, that the numbers, even in the most numerous age group,

for which figures are given, are probably insufficient to support definite conclusions.

The whole of the section of Dr. Young's report dealing with muscular pressures and facial dimensions seems important as pointing out directions for further investigation.

It may be worth while to call attention to some interesting correspondences between some of the points brought out here and some of those appearing in Dr. Young's analysis of the material collected by Miss L. M. Clinch on gum pad relationship in infants, and published in the *Transactions of the British Society for the Study of Orthodontics*, 1932.

Surveying the results of the investigation generally it would probably be unwise to say more than that it is encouraging as giving ground for thinking that some correlation does actually exist between " close bite," or certain forms of it, and facial dimensions, and that an extension of the investigation on similar lines could be expected to demonstrate them. In particular it would appear that the development of the " Prosopometer " has reached a point where it solves the chief difficulty of the early stages, that of recording with sufficient accuracy the vertical and horizontal dimensions of the face. (It would be more exact to say " the dimensions of the face in two directions at right angles to one another.)

It is useful then to consider what modifications in instruments or methods can be suggested as the result of the experience of this investigation.

(1) The most obvious point in this connection is that it is necessary to discover a field giving a more varied range of material than the Artane Schools.

(2) In view of the necessity for large numbers to obtain statistically valuable evidence it is desirable to reduce the number of measurements recorded if it can be shown that any of them are not of value for the purposes of the investigation. Head length and head breadth were in any case included only because it was considered that the main investigation provided an opportunity for obtaining these measurements on children, who have been little recorded. Zygomatic and gonial widths, molar and incisor bite, and some of the caliper measurements from the nasion, are others whose elimination might be considered.

(3) Dr. Young has raised the question of the basis for estimating the degree of " close bite." The present basis assumes a relationship between length of upper incisor and length of lower incisor. If there is actually no association between them a more reliable index of overbite would be given by including a record of upper incisor length. The assumed association has probably never been proved, but appears extremely likely to exist.

(4) The mathematical standard adopted for " close bite " may require revision.

(5) In view of what has been said above about the likelihood that " close bite " is not one indivisible condition it would appear desirable to extend the scheme of selection on the basis of clinical experience for purposes of comparison with normal and between groups. This would necessitate much larger numbers of " close bite " cases than where all such were grouped together.

(6) Some saving of time can be effected by a revision of the methods of charting measurements.

(7) It is desirable to make some modification to the prosopometer with a view to easier adjustment and a reduction of the tendency occasionally apparent for operation of the pointer to exert a drag on the ears. The substitution of a plane passing through the external auditory meatuses, and the nasion for the present approximation to the Frankfurt plane seems to have advantages, as eliminating one potential source of error (the location of the lowest point of the lower border of the orbit). The suggested plane coincides fairly well with the division between cranium and masticatory face.

In conclusion, thanks are due to a number of persons who assisted in the investigations. The value of Dr. Matthew Young's part on the statistical side is evident, but in many other directions his advice was invaluable. The Order of Christian Brothers not only made the investigation possible by giving access to the Artane School, but gave very kindly help in every way.

Miss K. C. Smyth, L.D.S.E., and Miss M. Still, L.D.S.E., Miss Wilson and Mr. Craig, B.Dent. Sc., took charge of particular branches of the recording and gave most valuable assistance.

PART II.
STATISTICAL ANALYSIS OF THE ARTANE DATA.

By Dr. M. Young.

The correlation between the amount of overbite and the facial characters.

As a preliminary step to the comparison of the various facial characters in the two groups of boys obtained by an arbitrary division of the whole series into those considered to have a normal and those an excessive overbite or "close bite," it seemed to be advisable to determine which of the numerous characters that had been measured were most closely associated with the degree of overbite. In the whole series of boys from 9 to 16 years of age, fully 400 in number, the degree of overbite varied from 0, where none of the left lower incisor was overlapped by the upper, to 100 per cent., where the lower incisor was overlapped by the upper in its whole extent, and the frequency distribution of the percentage overlapped in the individual boys, a ratio which may be termed the index or degree of overbite, formed a fairly symmetrical curve. Correlation co-efficients were thus calculated between the index of overbite and the various characters, static and dynamic, which had been measured. These co-efficients are shown in Table I. Amongst the features brought to light in this table, to which attention may specially be drawn are (1) that there is no appreciable correlation between the index of overbite and age, and (2) that of the three dynamic characters, strength of molar bite, lip pressure and tongue pressure, the last mentioned is the only one that shows a significant correlation with the amount of overbite. The degree of association although apparently real is very slight and inverse in character, represented by a co-efficient of –0.12, suggesting a very slight tendency for the degree of overbite to increase with decrease of tongue pressure.

Several of the other characters under review in the table show a significant though very slight degree of association with the

amount of overbite. Considering, in the first place, the facial measurements in the vertical direction, F P to U I G M and F P to U I I M show a slight positive association, while F P to L I G M shows a slight negative association with the amount of overbite. The two last mentioned correlations probably cannot, however, be attributed wholly to an organic relationship as the F P to U I I M and the F P to L I G M measurements include or "cover" one or other of the absolute measurements which provide the index of overbite. There is no significant association between the degree of overbite and any of the other dimensions, F P to N, F P to M P, B at $\underline{6 \mid 6}$, the depth of the mandible (including the teeth) in the molar or incisor regions or the height of the left lower incisor, $\overline{1 \mid}$.

TABLE I.

Correlation co-efficients. showing the association between the degree of overbite and the facial characters in boys from 9 to 16 years.

Variables.		*r.*
Index of overbite and strength of left molar bite ..	(360)	− ·007 ± ·053
Index of overbite and tongue pressure	(414)	− ·120 ± ·048
Index of overbite and lip pressure	(399)	− ·014 ± ·050
Index of overbite and L Mol. to L B M	(402)	− ·018 ± ·050
Index of overbite and L Incis. to S M P	(401)	·078 ± ·050
Index of overbite and N to $\underline{6 \mid 6}$	(401)	− ·002 ± ·050
Index of overbite and F P to N	(415)	·039 ± ·049
Index of overbite and F P to U I G M	(415)	·152 ± ·048
Index of overbite and F P to U I I M	(396)	·133 ± ·049
Index of overbite and F P to L I G M	(414)	− ·183 ± ·048
Index of overbite and F P to M P	(415)	− ·078 ± ·049
Index of overbite and T A to U I G M (horiz.) ..	(414)	·051 ± ·049
Index of overbite and T A to M P (horiz.)	(400)	− ·005 ± ·050
Index of overbite and T A to Gon. (rad.)	(400)	− ·005 ± ·050
Index to overbite and Gon. to M P	(400)	− ·065 ± ·050
Index of overbite and L U A	(403)	− ·127 ± ·049
Index of overbite and L L A	(403)	− ·292 ± ·046
Index of overbite and 100 × L L A/L U A	(403)	− ·210 ± ·048
Index of overbite and height of $\overline{1 \mid}$	(415)	− ·034 ± ·049
Index of overbite and zygomatic breadth	(395)	− ·047 ± ·050
Index of overbite and B at $\underline{6 \mid 6}$	(351)	− ·139 ± ·052
Index of overbite and B at $\overline{\overline{6 \mid 6}}$	(364)	− ·140 ± ·051
Index of overbite and B at $\underline{4 \mid 4}$	(287)	− ·135 ± ·058
Index of overbite and B at $\overline{D \mid D}$ or $\underline{4 \mid 4}$	(349)	− ·112 ± ·053
Index of overbite and B at $\overline{4 \mid 4}$ $\underline{\quad}$	(251)	− ·159 ± ·062
Index of overbite and B at $\overline{\overline{D \mid D}}$ or $\overline{4 \mid 4}$	(319)	− ·101 ± ·055
Index of overbite and mandibular angle	(396)	·037 ± ·050
Index of overbite and age	(396)	·064 ± ·050
F P to U I I M and age	(396)	·353 ± ·044
100 × L L A/L U A and age	(403)	− ·201 ± ·048

With regard to antero-posterior measurements of the face or jaws, it is found that the index of overbite is inversely associated with the lengths of both the upper and lower dental arches; with the lower arch, the degree of association is represented by a co-efficient of about −0.3 which is more than double that shown with the upper arch. Considering the number of observations available, such a difference represents a significantly closer degree

of association with L L A than L U A. The association between the degree of overbite and the length of the lower dental arch is the highest shown between the index and any of the facial characters under review in the table. There is no significant association, however, between the degree of overbite and any of the other antero-posterior measurements, namely Gon. to M P, T A to U I G M (horiz.), T A to M P (horiz.) or T A to Gon. (radial).

Turning to facial measurements in the transverse direction, or measurements of width, it is found that the degree of overbite is associated to a slight but significant degree with the widths of the upper and lower dental arches both at 4 | 4 and 6 | 6. The association with the various widths is of an inverse character and practically equivalent, being represented by co-efficients of from –0.13 to –0.16.

The zygomatic breadth of the face, on the other hand, is apparently unrelated to the degree of overbite.

There is no association between the amount of overbite and the size of the mandibular (gonial) angle.

As the correlation between the index of overbite and age is practically negligible the coefficients given in the table are not materially reduced in value when the influence of age in determining to some extent the size of the coefficients is eliminated.

Comparison of the mean values of the several facial characters in the groups of boys with normal overbite and " close bite " respectively.

Having determined by the method of correlation the facial characters in which differences might probably be observed in the " normal " and " close bite " groups of boys as divided arbitrarily, the mean values and variabilities of these and some other characters were then compared in the boys at corresponding ages with the two types of bite. To obtain larger samples and so reduce the standard errors of the averages, the boys were taken in the two-yearly groups, 10 and 11, 12 and 13, 14 and 15 years. The detailed comparison of the mean values and variabilities of the selected characters in the three age groups in the boys considered to have " close bite " and those considered to have normal bite is shown in Table II. Adopting the usual convention that a difference in two means should only be considered statistically significant or real if it exceeds twice its standard error (i.e., $M_1 \backsim M_2$ is $> 2\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$ or approximately the 0.05 or 1 in 20 level of significance), the comparable means that satisfy this criterion have been indicated in heavy type. A glance at the table shows that there are only three of the characters which may be regarded as probably really different in the boys with the two types of dentition. These are L L A, 100 x L L A/L U A and F P to L I G M. For the last character, the mean value in boys with normal bite at ages 10 and 11 years cannot be considered actually significantly in excess of that for boys with " close bite " at these ages, as the difference is not quite twice its standard error, but it almost satisfies this criterion. At the later ages the mean values of this character in the " normal " boys are significantly in excess of these for boys

with " close bite." For some of the other characters under review, namely, B at $\underline{4 \mid 4}$, B at $\underline{6 \mid 6}$, B at $\overline{6 \mid 6}$, and tongue pressure, the average values in boys with normal bite at ages 14 and 15 are significantly in excess of the corresponding values in boys with excessive overbite, but at the other ages, the differences in the corresponding means in normal and " close bite " groups cannot be considered real on the numbers of observations available. There is no definite evidence in these data that the depth of the mandible in the molar region, as indicated by the measurement L M to L B M, in the boys with " close bite " is less than the normal.

TABLE II.

Showing a comparison of the means and variabilities of several facial characters in groups of boys with normal bite and " close bite " at corresponding ages.

Age groups			Bite L. Molars	Bite R. Molars	Bite Incisors	Tongue pressure	TA to Gon. (rad.)	Gon. to MP	TA to LIGM (hor.)
10 and 11 yrs.	N.B.	M.**	47·64±1·57	46·15±1·47	19·37±0·83	1·33±0·06	44·87±1·04	72·33±0·73	73·26±0·58
		S.D.	11·64	10·72	6·23	0·49	7·85	5·49	4·39
		N.	55	53	57	57	57	57	57
	C.B.	M.	49·26±1·72	44·63±1·91	18·61±1·07	1·44±0·08	42·09±1 09	71·84±0·76	72·78±0·52
		S.D.	11·14	12·10	7·23	0·53	7·39	5·15	3·53
		N.	42	40	46	46	46	46	46
12 and 13 yrs.	N.B.	M.	53·54±1·52	51·03±1·47	19·64±0·81	1·55±0·06	45·42±0·75	74·26±0·63	74·47±0·47
		S.D.	13·43	12·90	7·44	0·55	6·90	5·80	4·31
		N.	78	77	85	85	85	85	85
	C.B.	M.	53·32±1·17	50·11±1·28	20·20±0·76	1·47±0·06	46·25±0·77	72·86±0·64	74·00±0·49
		S.D.	10·24	11·05	7·24	0·57	6·53	5·39	4·62
		N.	76	74	90	90	89	89	90
14 and 15 yrs.	N.B.	M.	64·16±2·11	61.57±2·63	23·33±1·08	*1·80±0·08	48·14±0·67	76·23±0·73	76·75±0·58
		S.D.	15·09	18·04	8·42	0·62	5·27	5·72	4·54
		N.	51	47	61	61	61	62	61
	C.B.	M.	59·84±2·64	59·44±3·03	21·65±1·03	*1·45±0·09	48·79±1·08	75·61±0·82	76·04±0·66
		S.D.	16.05	18·91	7·39	0·61	7·71	5·82	4·73
		N.	37	39	51	51	51	51	51

Age groups			TA to MP (hor.)	FP to UIIM	N to $\underline{6 \mid 6}$	L Incis. to SMP	L Mol. to LBM	LUA	LLA
10 and 11 yrs.	N.B.	M.	68·50±0·90	44·71±0·51	68·79±0·45	37·00±0·28	*31·03±0·27	38·57±0·24	*33·95±0·24
		S.D.	6·82	3·84	3·36	2·14	1·98	1·79	1·80
		N.	57	56	55	57	55	54	55
	C.B.	M.	67·40±0·96	45·44±0·50	69·24±0·54	36·81±0·32	*30·05±0·27	38·02±0·30	*32·66±0·26
		S.D.	6·53	3·34	3·61	2·11	1·82	1·99	1·74
		N.	46	45	45	45	45	44	44
12 and 13 yrs.	N.B.	M.	69·76±0·81	47·07±0·42	71·87±0·49	38·38±0·32	31·93±0·27	38·30±0·27	*33·12±0·28
		S.D.	7·49	3·88	4·49	2·90	2·50	2·47	2·54
		N.	85	84	84	84	84	85	85
	C.B.	M.	68·77±0·76	47·49±0·42	71·46±0·51	38·53±0·26	31·97±0·21	37·61±0·26	*31·75±0·24
		S.D.	7·24	4·00	4·74	2·45	1·95	2·41	2·22
		N.	90	90	87	88	86	88	87
14 and 15 yrs.	N.B.	M.	70·98±0·90	48·00±0·47	74·55±0·45	39·28±0·32	33·92±0·29	37·35±0·25	*32·40±0·24
		S.D.	7·09	3·61	3·50	2·51	2·26	1·95	1·81
		N.	62	60	60	61	60	60	59
	C.B.	M.	72·74±1·03	48·26±0·61	73·54±0·53	39·49±0·30	33·43±0·33	37·00±0·39	*31·34±0·31
		S.D.	7·32	4·34	3·67	2·17	2·34	2·77	2·19
		N.	51	51	48	51	50	50	50

* Indicates the comparable means that can be considered to differ to a significant degree.
M.**= mean and its standard error.
S.D.= standard deviation.
N. = number of observations.

Age groups			100 x LLA / LUA	FP to UIGM	FP to LIGM	B at 4|4	B at 6|6	B at 4|4	B at 6|6
10 and 11 yrs.	N.B.	M.	*88·11 ± 0·48	36·88 ± 0·50	50·02 ± 0·43	44·04 ± 0·39	55·50 ± 0·29	38·76 ± 0·35	53·69 ± 0·26
		S.D.	3·50	3·85	3·26	2·52	2·07	2·17	1·90
		N.	54	58	58	41	51	38	52
	C.B.	M.	*86·16 ± 0·62	37·91 ± 0·62	48·92 ± 0·45	44·19 ± 0·27	56·20 ± 0·29	38·88 ± 0·35	53·81 ± 0·36
		S.D.	4·05	4·17	3·04	1·73	1·85	2·00	2·33
		N.	43	45	45	42	40	32	42
12 and 13 yrs.	N.B.	M.	*86·20 ± 0·41	39·38 ± 0·45	*52·11 ± 0·42	45·01 ± 0·23	56·49 ± 0·28	39·74 ± 0.21	54·56 ± 0.23
		S.D.	3·81	4·17	3·84	1·98	2·43	1·80	2·05
		N.	85	85	85	73	75	71	77
	C.B.	M.	*84·56 ± 0·49	39·93 ± 0·43	*50.67 ± 0·39	44·63 ± 0·28	56·18 ± 0·28	39.21 ± 0·25	54·03 ± 0.26
		S.D.	4·56	4·06	3·72	2·47	2·51	2·11	2·31
		N.	87	90	90	78	79	70	80
14 and 15 yrs.	N.B.	M.	*86·46 ± 0·49	40·44 ± 0·52	*52·93 ± 0·49	*45·71 ± 0·29	*57·03 ± 0·36	40·26 ± 0·26	*55·04 ± 0·28
		S.D.	3·73	4·10	3·81	2·14	2·60	1·94	2·06
		N.	59	61	60	56	51	55	54
	C.B.	M.	*84·72 ± 0·69	40·35 ± 0·53	*51·15 ± 0·50	*44·73 ± 0·40	*55·09 ± 0·42	39·71 ± 0·29	*53·74 ± 0·28
		S.D.	4·90	3·84	3·58	2·64	2·53	1·83	1·79
		N.	50	52	52	44	37	41	41

* Indicates the comparable means that can be considered to differ to a significant degree.
M.** = mean and its standard error.
S.D.= standard deviation.
N. = number of observations.

A notable feature of what may be termed the dynamic characters analysed in Table II is the high degree to which they vary in the relatively narrow age groups. For the strength of the molar bite, the variability as measured by the coefficient of variation (100 × S.D./mean) is about 25 per cent., it is over 30 per cent. for the strength of the incisor bite and over 35 per cent. for tongue pressure. The most variable of the static characters is the measurement T A to Gonion, for which the coefficient of variation is about 15 per cent. With such relatively wide variation and samples of only moderate size, mean differences in boys with the two types of " bite " would have to be fairly large to be considered statistically significant.

Comparison of the mean values of some of the facial characters in boys with normal overbite and those in boys with well-defined functional " close bite."

As the mean measurements of the several facial characters in boys with " close bite," in which category all those with even the slightest degree of excessive overbite were included seemed to differ so inappreciably, with two or three exceptions to which reference has been made, from the corresponding measurements in boys at the same ages with normal overbite, a selection of the dental arch models of boys which appeared to the investigators to show clearly defined functional " close bite " was made, excluding all those that were associated with caries or premature extraction, in the hope that an examination of the mean measurements in these cases might possibly reveal some divergence from the normal. These selected cases were divided into two groups :—

(1) Characterised by normal molar occlusion.
(2) Characterised by a posterior relationship of the lower molars to the upper.

Unfortunately, the total number in the selected series was relatively small, comprising just over 50 at all ages. Of this total

10 fell into the age group 10 to 12 years, 29 into the age group 12 to 14 years, and 12 into the group 14 to 16 years. More than half the number thus fell into the intermediate age group, and of the 29 in this group 17 belonged to Class 1 and 12 to Class 2. This group was the only one that seemed large enough to warrant further analysis. The mean values of a selected series of characters were calculated for the boys in this age group as a whole and in the two sub-classes (1) with normal occlusion, and (2) with post-normal molar occlusion. These values are shown in comparison with the corresponding means for boys with normal overbite at ages 12 and 13 in Table III.

Comparing the boys as a whole showing definite functional "close bite" (Classes 1 and 2) with the boys showing normal overbite, it is seen that the length of the lower dental arch (L L A) is the only static facial character of those tabulated in which the boys with "close bite" can be said to differ significantly from the boys with normal overbite. It is less in the abnormal group. Of the three dynamic characters, tongue pressure is the only one that shows a real difference in the normal overbite and "close bite" groups. It is apparently less in the latter.

TABLE III.

Showing a comparison of the mean values and variabilities of a series of the facial characters in the specially selected boys with "close bite," at ages 12 and 13 years, and the corresponding values in boys with normal overbite at the same ages.

		LUA	LLA	100 LLA/LUA	B at 4|4	B at 6|6	B at $\overline{4\|4}$
Class 1	M.	**38·32***	31·96	**83·52***	**45·61***	**57·00***	39·40
	N.	16	16	16	17	17	13
Class 2	M.	**35·96***	31·21	**86·87***	**42·57***	**54·06***	38·83
	N.	12	12	12	10	12	12
Classes 1 and 2 together	M.	37·31 ± 0·45	*31·64 ± 0·36	84·95 ± 0·75	44·44 ± 0·45	55·78 ± 0·48	39·12 ± 0·33
	S.D.	2·36	1·89	3·97	2·28	2·58	1·90
	N.	28	28	28	26	29	25
Normal over-bite	M.	38·30 ± 0·27	*33·12 ± 0·28	86·20 ± 0·41	45·01 ± 0·23	56·49 ± 0·28	39·74 ± 0·21
	S.D.	2·47	2·54	3·81	1·98	2·43	1·80
	N.	85	85	85	73	75	71

		B at $\overline{6\|6}$	FP to UIIM	FP to UIGM	FP to LIGM	$\overline{6\|6}$ to LBM	
Class 1	M.	**54·93***	48·56	41·08	51·38	32·35	
	N.	17	17	17	17	17	
Class 2	M.	**52·86***	47·45	39·88	49·60	31·36	
	N.	12	12	12	12	11	
Classes 1 and 2 together	M.	54·07 ± 0·41	48·10 ± 0·76	40·58 ± 0·79	50·64 ± 0·69	31·96 ± 0.34	
	S.D.	2·22	4·12	4·23	3·74	1·81	
	N.	29	29	29	29	28	
Normal over-bite	M.	54·56 ± 0·23	47·07 ± 0·42	39·38 ± 0·45	52·11 ± 0·42	31·93 ± 0·27	
	S.D.	2·05	3·88	4·17	3·84	2·50	
	N.	77	84	85	85	84	

Class 1. Close bite with normal molar occlusion.
Class 2. Close bite with post-normal molar occlusion.

* Indicates the comparable means that can be considered to differ to a significant degree.

		L incis. to SMP	Left Molar Bite	Tongue pressure	Lip pressure
Class 1	M.	39·18	55·47	1·21	0·71
	N.	17	17	17	17
Class 2	M.	38·59	49·73	1·26	0·81
	N.	11	11	12	12
Classes 1 and 2 together	M.	38·95±0·38	53·21±1·69	*1·23±0·08	0·75±0·04
	S.D.	2·02	8·94	0·45	0·19
	N.	28	28	29	29
Normal over-bite	M.	38·38±0·32	53·54±1·52	*1·55±0·06	0·78±0·02
	S.D.	2·90	13·43	0·55	0·15
	N.	84	78	85	84

Class 1. Close bite with normal molar occlusion.
Class 2. Close bite with post-normal molar occlusion.

* Indicates the comparable means that can be considered to differ to a significant degree.

When the mean values of the characters in the boys with "close bite," but normal antero-posterior molar occlusion (Class I) are compared with the corresponding averages in boys with post-normal molar occlusion (Class II), using the appropriate test for the significance of mean differences in small samples, it is found that in the post-normal group the length of the upper dental arch (L U A) and the breadths of the dental arches at $\frac{4 \mid 4}{}$, $\frac{6 \mid 6}{}$ and $\overline{6 \mid 6}$ are all significantly less than in the boys with "close bite" associated with normal molar occlusion. There is no significant difference, however, in the two groups of boys in the mean length of the lower dental arch (L L A), nor in any of the vertical measurements of the face and jaws, F P to U I I M, F P to U I G M, F P to L I G M, $\overline{6 \mid 6}$ to L B M or L incisors to S M P, nor in any of the three dynamic characters.

Although differences that appear to be statistically significant or real do occur in a small number of the characters which have been compared in the two groups of boys with normal and post-normal occlusion respectively, the relatively small numbers on which the averages are based scarcely warrant much emphasis being laid on the possibility of their importance.

The association between the dynamic characters, strength of molar bite, tongue pressure and lip pressure, and the facial dimensions.

In view of the fairly prevalent belief amongst orthodontists that function, or rather exercise of function or functional activity, is an important factor in jaw development, it seemed very desirable to ascertain what association, if any, obtained between the three dynamic characters, strength of molar bite, tongue pressure and lip pressure—characters which may be considered to be to some extent measures of muscular function in mastication—and the dimensions of the face and jaws in the series of boys from 9 to 16 years of age. The strength of association that exists between the respective dynamic characters and a selected series of the dimensions of the face and jaws may readily be seen from the correlation coefficients given in Tables IV and V. Table IV gives the total correlations between the characters considered, and Table V the partial coefficients, showing the degree of association

that persists when the influence of age has been eliminated. In computing the coefficients, the boys were taken as one group, as the correlation coefficients found between strength of molar bite and some of the facial characters and between lip pressure and L U A did not show any significant differences in the two sub-groups of boys with normal bite and " close bite " respectively.

Before considering the coefficients in Table V, to which special attention will be directed later, reference must be made to some of the coefficients in Table IV, which are so small in comparison with their standard errors that they indicate clearly that no real association exists between the respective characters. The strength of the molar bite is apparently quite unrelated to the shape of the head, or to the size of the mandibular (gonial) angle, although well-developed masticatory muscles might conceivably have shown some association with both of these characters—indeed, such a relationship has been suggested by some observers.

TABLE IV.

Showing the correlation between the dynamic characters, strength of molar bite, lip pressure and tongue pressure and the dimensions of the face and jaws.

Variables.		*r.*
Left molar bite and zygomatic breadth	(354)	·459 ± ·042
Left molar bite and bigonial breadth	(354)	·368 ± ·047
Left molar bite and cephalic index	(353)	·083 ± ·053
Left molar bite and L M to L B M	(354)	·361 ± ·046
Left molar bite and L Incis. to S M P	(354)	·224 ± ·051
Left molar bite and gonial angle	(354)	−·082 ± ·053
Left molar bite and B at $\frac{6 \mid 6}{}$	(316)	·279 ± ·052
Left molar bite and B at $\overline{6 \mid 6}$	(325)	·279 ± ·052
Left molar bite and B at $\frac{4 \mid 4}{}$	(247)	·365 ± ·055
Left molar bite and B at $\overline{4 \mid 4}$	(215)	·293 ± ·062
Left molar bite and tongue pressure	(359)	·275 ± ·049
Left molar bite and lip pressure	(359)	·168 ± ·051
Left molar bite and left hand grip	(359)	·432 ± ·043
Left molar bite and L U A	(355)	·039 ± ·053
Left molar bite and L L A	(355)	·054 ± ·053
Tongue pressure and L U A	(402)	·006 ± ·050
Tongue pressure and L L A	(402)	−·054 ± ·050
Tongue pressure and B at $\frac{6 \mid 6}{}$	(344)	·208 ± ·052
Tongue pressure and B at $\overline{6 \mid 6}$	(344)	·226 ± ·051
Lip pressure and L U A	(399)	−·290 ± ·046
Lip pressure and L L A	(399)	−·226 ± ·048
Lip pressure and B at $\frac{6 \mid 6}{}$	(341)	·021 ± ·054
Lip pressure and B at $\overline{6 \mid 6}$	(341)	·169 ± ·053
Tongue pressure and lip pressure	(399)	·269 ± ·046
Left molar bite and right molar bite	(344)	·841 ± ·016
Left molar bite and age	(359)	·405 ± ·044
Right molar bite and age	(352)	·372 ± ·046
Left hand grip and age	(359)	·597 ± ·034
Gonial angle and age	(354)	−·082 ± ·053
Zygomatic breadth and age	(354)	·470 ± ·041
Bigonial breadth and age	(354)	·426 ± ·044
L Mol. to L B M and age	(354)	·503 ± ·040
L Incis. to S M P and age	(354)	·381 ± ·046
B at $\overline{6 \mid 6}$ and age	(325)	·158 ± ·054
Tongue pressure and age	(344)	·233 ± ·051
Lip pressure and age	(399)	·254 ± ·047
L U A and age	(403)	−·162 ± ·049
L L A and age	(403)	−·300 ± ·045

TABLE V.

Showing the correlation between the dynamic characters, strength of molar bite, lip pressure and tongue pressure, and the facial dimensions, when the influence of age is eliminated.

Variables.		*r.*
Left molar bite and zygomatic breadth with age constant	(354)	·335 ± ·047
Left molar bite and bigonial breadth with age constant	(354)	·239 ± ·050
Left molar bite and L Mol. to L B M with age constant	(354)	·202 ± ·051
Left molar bite and L Incis. to S M P with age constant	(354)	·084 ± ·053
Left molar bite and breadth at $\overline{6 \mid 6}$ with age constant	(325)	·237 ± ·052
Left molar bite and tongue pressure with age constant	(359)	·204 ± ·051
Left molar bite and lip pressure with age constant	(359)	·073 ± ·053
Left molar bite and left hand grip with age constant	(359)	·259 ± ·049
Left molar bite and right molar bite with age constant	(334)	·813 ± ·019
Tongue pressure and breadth at $\overline{6 \mid 6}$ with age constant	(344)	·197 ± ·052
Tongue pressure and lip pressure with age constant	(344)	·223 ± ·048
Lip pressure and breadth at $\overline{6 \mid 6}$ with age constant	(325)	·135 ± ·055
Lip pressure and L U A with age constant	(399)	−·260 ± ·047
Lip pressure and L L A with age constant	(399)	−·163 ± ·049

The strength of the molar bite shows no association with the lengths of the upper or lower dental arches. The lengths of the dental arches are also quite independent of the tongue pressure. Lip pressure does not show any association with the breadth of the arch at $\overline{6 \mid 6}$.

When the influence of age in determining to some extent the size of the coefficients is eliminated, a significant or real association still obtains, however, between the dynamic characters and some of the dimensions of the face and jaws (Table V). The degree of association between the strength of the molar bite and the zygomatic breadth is represented by a coefficient of 0.34, and that between the molar bite and the bigonial breadth is 0.24. On the number of observations available these coefficients do not, however, indicate any real difference in strength of association. The strength of the molar bite shows too a slight but real association with the depth of the mandible in the molar region ; increase in strength of molar bite has apparently a slight tendency to be accompanied by an increase in mandibular depth. On the other hand, there is no significant association between strength of molar bite and the depth of the mandible (including the incisors) in the incisor region (L incisors to S M P). The strength of the molar bite also shows a slight but real association with the breadth of the arch at $\overline{6 \mid 6}$ (and probably an equivalent relationship with the breadth at $\overline{6 \mid 6}$, although this partial coefficient has not been computed). Both the tongue pressure and the lip pressure have a very slight but significant positive association with the breadth at $\overline{6 \mid 6}$. The lengths of both upper and lower dental arches show on the other hand a slight but significant tendency to decrease with increase of lip pressure.

When the interrelations of the three dynamic characters are examined it is found that the strength of the molar bite has a slight but significant positive association with the tongue pressure. The coefficient of correlation is approximately 0.2 and is practically

equivalent to that found to exist between the strength of the molar bite and the strength of the hand grip. There is also a slight but real association between lip pressure and tongue pressure, but no appreciable relationship between the lip pressure and the strength of the molar bite. The correlation between the strength of the molar bite on the right and left sides, when the influence of age is eliminated, is represented by a coefficient of 0.8. This association, though of a high degree might reasonably have been expected to be higher.

Johnson and Hatfield* have pointed out that while there is usually a very close agreement between the biting force at the first molars on the right and left sides of the jaw in boys with " normal " dentures, one side of the jaw often registers a force of 20 or 30 lbs. less than the other side in boys with malocclusion. In the group of Artane boys with normal incisor bite and normal occlusion, the degree of association between the force of the molar bite on the right and left sides is, however, practically equivalent to that found in the group with " close bite " and any form of occlusion elsewhere (the respective correlation coefficients, uncorrected for age are : .840 ± .022 and .858 ± .022). The inclusion of the cases of malocclusion thus does not appear to account for any reduction of the association that obtains in normal boys.

* *Dental Cosmos*, 1917, pp. 509-609.

ABBREVIATIONS.

F P	=	Frankfurt Plane.
U I G M	=	Upper Incisor Gum Margin.
U I I M	=	Upper Incisor Incisal Margin.
L I G M	=	Lower Incisor Gum Margin.
N	=	Nasion.
M P	=	Mental Prominence.
B	=	Breadth.
L U A	=	Length Upper Arch.
L L A	=	Length Lower Arch.
Gon.	=	Gonian.
T A	=	Transmeatal Axis.
L B M	=	Lower Border Mandible.
L M	=	Lower Molar.
S M P	=	Submental Point.

THE annual general meeting of the Society was held at Manson House, 26, Portland Place, W.1, on Monday, December 4th, 1933. Mr. H. G. Watkin (president), was in the chair.

The minutes of the last meeting were read and confirmed.

Mr. B. G. F. Turner, a new member, whose election had been confirmed at an ordinary meeting, came forward for introduction to the President.

HON. SECRETARY'S REPORT.

I am happy to report that the past year has seen a further expansion of all aspects of the Society's activities. The new Headquarters have proved in every way satisfactory, and, as our relations with the Council of the Royal Society of Tropical Medicine remain on a cordial basis, no difficulty is anticipated in the completion of a long term agreement. Scrutinising the membership, it is noted that 20 new members have been elected, this comparing favourably with 15 in the previous year; 3 have resigned, 2 have died, so that the membership now stands at 266. Again, it is encouraging to note the steadily increasing attendance at meetings, the average for the year being not less than 62. Seven meetings were held on the usual dates, the President's address proving both interesting and instructive, whilst the remainder covered a diversity of subjects. The main programme for 1934 is now complete, but the Executive are always most pleased to consider, and to accept, further offers of communications from all sections of the membership, so that the monthly meetings will continue to be fully representative of the corporate spirit of the Society.

HON. CURATOR'S ANNUAL REPORT.

I wish to say that I am very pleased to be able to report that the Museum cabinets are once again properly housed in the Society's headquarters after an interval of about ten years.

The specimens have all been arranged, but many of these, I am afraid, are getting rather out of date and I would welcome offers of material from members, or other sources that members would care to suggest.

Additional exhibits have been added this year, presented by Miss Clinch and Dr. Sheldon Friel; also I have several other promises of exhibits which I trust I shall receive in due course.

The PRESIDENT announced that the officers and councillors, nominated by the Council, whose names were set out were elected. No other nomination for the officers had been received, and the private nomination received for the office of councillor, as mentioned in the agenda, had been withdrawn, and a ballot would therefore not be necessary.

OFFICERS AND COUNCILLORS, 1934.

The following have been nominated by the Council :—

President	Mr. B. SAMUEL.
Immediate Past President ...	Mr. H. G. WATKIN.
Vice-Presidents	Mr. A. L. PACKHAM.
	Mr. F. B. BULL.
	Mr. ST. J. STEADMAN.
Secretary	Mr. R. CUTLER.
Treasurer	Mr. H. R. EVANS.
Curator	Mr. H. C. HIGHTON.
Librarian	Miss K. C. SMYTH.
Editor	Mrs. L. LINDSAY.
Councillors	Mr. S. A. RIDDETT.
	Mr. H. CHAPMAN.
	Mr. N. GRAY.

The PRESIDENT invited nominations for the office of Auditor.
The SECRETARY nominated Mr. Russell Marsh.
Mr. PACKHAM seconded.
Mr. SAMUEL nominated Mr. Southwood.
Mr. STEADMAN seconded.
Mr. Marsh and Mr. Southwood were elected by a show of hands.

THE NEW PRESIDENT.

The PRESIDENT said it was now his duty to invest the new President, Mr. B. Samuel, with the badge of office. In doing so he wished him every success in his year of office, and expressed his confidence that Mr. Samuel would enjoy the same support from everybody in the Society as he himself had received.

The NEW PRESIDENT thanked his predecessor for his good wishes.

Mr. NORTHCROFT moved a hearty vote of thanks to the Immediate Past President, saying he was sure all would agree with him that they had greatly enjoyed Mr. Watkin's term of office, and that they hoped he would long be spared to give the Society the benefit of his advice and experience and to give accounts of some more of his delicate mechanical inventions. In Mr. Watkin the Society had a very valuable member, one who was keen not only on his work but on the advance of the science of orthodontics.

The proposition was carried by acclamation, and the PAST PRESIDENT briefly acknowledged the vote.

Mr. CHAPMAN proposed a hearty vote of thanks to the Secretary and the other officers who had so ably seconded the President in his work during the year.

The vote was passed by acclamation.

HON. TREASURER'S REPORT (Mr. H. R. EVANS.)

During the past year the Society's income has been £250 2*s.* 6*d.*; an increase of roughly £14 on the previous year. This sum is chiefly from members' subscriptions.

The expenditure has been £203 1*s.* 7*d.*, an increase of £46 16*s.* 6*d.* on last year.

This leaves a credit balance of £47 0*s.* 11*d.*

The additional expenditure this year is due mainly to the increase in rent.

The Society's assets are as follows:—500 National Savings Certificates, present value £512 10*s.*; cash on deposit, £190; cash at the bank and in hand, £27 16*s.* 2*d.*, making a total of £730 6*s.* 2*d.*, as against £665 5*s.* 2½*d.* last year.

Mr. NORTHCROFT asked at what price the National Savings Certificates were bought.

The HON. TREASURER said the total was about £450, and he believed the price was about 16*s.* to the £.

Mr. NORTHCROFT moved the adoption of the report.

Mr. PACKHAM seconded, and the report was adopted.

BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS.

INCOME AND EXPENDITURE ACCOUNT, December 1st to November 30th, 1932–1933.

STATEMENT OF ACCOUNTS.

Receipts.	1931-2. £ s. d.	1932-3. £ s. d.
Members' Subscriptions	234 3 0	249 7 6
Deposit Interest	1 14 2	0 15 0

Assets.		1931-2. £ s. d.	
500 National Savings Certificates, value		512 10 0	
Deposit Account		190 0 0	
Cash at Bank		24 15 3	
	£ s. d.		
Cash in hand : Secretary	0 14 8		
Treasurer	1 9 11½		
Librarian	0 10 9½		
Editor	0 5 6		
		3 0 11	
Total ..		£730 6 2	

Payments.	1931-2. £ s. d.	1932-3. £ s. d.
Rent	12 12 0	48 15 0
Accommodation of Cabinets at Institute of Hygiene	6 6 0	1 14 6
Removal of Cabinets to No. 26, Portland Place	—	0 15 0
Making and Fitting of Panels to Cabinet	—	1 12 0
Printing and Transactions	63 6 3	69 7 5
Reporting	21 0 0	19 19 0
Refunded Subscriptions	—	7 7 0
Refreshments	15 15 0	23 5 0
Hire of Epidiascope	11 1 6	—
Hire of Electric Table Standards ..	2 2 0	2 2 0
Hire of Kodascope	—	2 11 6
Petty Cash	14 0 0	16 11 9
Bank Debits	0 8 6	0 8 4
Insurance on Books and Badges ..	1 7 4	0 15 0
Volume for Library	3 15 0	—
Costs of Agreement with Royal Society of Tropical Medicine ..	4 11 6	—
Photographs of Models for Demonstration	—	4 9 6
Travelling Expenses of Patient for Demonstration	—	3 3 0
Loss on Exchange (Wilkinson) ..	—	0 5 7
	156 5 1	203 1 7
Balance	79 12 1	47 0 11
Total ..	£235 17 2	£250 2 6

We have examined the above Statement of Accounts and found it correct.

(Signed) A. Garrow,
F. Laurence King, *Auditors.*